FROM LANGUAGE POLICIES TO CLASSROOM PRACTICE: CASE STUDIES OF MATHEMATICS TEACHING IN THREE RURAL SECONDARY SCHOOLS IN WALES.

by

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ABSTRACT

In this study, I consider the approaches adopted by rural secondary schools in Wales in the teaching of mathematics through the medium of Welsh during the latter part of the twentieth century and the first decade of the twenty first century. The policy context of Welsh medium mathematics development is based on a range of documents from Welsh language schemes submitted for approval to a central body, to inspection reports of schools.

This account of the policy context is followed by an analysis of how mathematics is being taught and learned in the classroom. The schools I approached were in two contrasting Local Education Authorities where the social linguistic and policy conditions varied substantially. In conducting the school-based research I adopted different research methods, which included semi-structured interviews with teachers in three schools, and subsequently classroom observation in two of those schools combined with classroom audio recordings of three types of classes, Welsh medium, bilingual and English medium classes.

The findings of this study have consequences for language-in-education policy in Wales. By focusing on the teacher discourse, linguistic markers, teacher encouragement and use of standardized terms in all classrooms, a more inclusive and participatory climate can be created.

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GLOSSARY OF TERMS AND CONCEPTS RELATED TO UK-WIDE EDUCATION

1) Comprehensive education: The definition suggested by (Gerwitz, Ball and Bowe, 1995: 187) is more than adequate to capture the established view.

   " A comprehensive system of educational provision is based on the principle that it is socially and educationally advantageous for all children, whatever their ability, class or ethnic background, to be educated together in a common school and in mixed ability groups, and that all children should have access to a learning environment which enables them to realize their potential."

2) Core subjects: These subjects are tested at Key stages, they are English, mathematics and science.

3) Foundation subjects: These are subjects other than the core subjects, and form part of the structure of the National Curriculum. They are not compulsory from age 14 and include, technology, history, geography, art, music and a modern foreign language for pupils aged 11 to 14.

4) GCSE: The General Certificate of Education taken at 16 years of age.

5) Grant Maintained (GM) Status or Opting out: These were schools that received a direct grant from the State. The Labour Government 1997- withdrew Grant Maintained status.

6) INSET: This stands for In-service Education for Teachers and is used to designate training days for teachers.

7) Key Skills: These were added to the KS5 curriculum. They involved cross-curricular work in Communication, Numeracy and Information Technology. The idea of teaching "Key Skills" was rolled out very quickly, perhaps in response to a "back to basics" discourse in the early 1990s. Some expressed concern over its implementation.

8) Key Stages: The National Curriculum is organised according to four Key Stages. However, a fifth Key Stage has been added for pupils over 16 years of age.
   Key Stage 1 relates to primary school children aged 5 to 7 years.
   Key Stage 2 relates to primary school children aged 7 to 11

Key Stages 3 to 5 refer to pupils in secondary schools.

Key Stage Three (KS3): This relates to pupils in years 7 to 9 who face SAT tests at the age of 14.

Key Stage Four (KS4): This relates to pupils in years 10 and 11 who face GCSE examinations at the age of 16.

Key Stage 5 (KS5): This relates to pupils in years 12 and 13, they face a combination of examinations from A levels to vocational courses.

9) Local Education Authorities (LEAs): These represent the middle tier of policy implementation in the education system in both England and Wales. Neo liberal educational reforms have steadily undermined their influence. Under the Labour Government in 1997, however, they re-cast their role as partners.

10) Local management of Schools (LMS): Allowed all schools to take control of their delegated budgets. In practice, this allowed some schools to prioritise their commitment to specific areas of the curriculum. The area of delegated responsibilities steadily increased, meaning LEA services had to compete with other providers. LMS therefore disrupted some local rules in a way similar to GM schools.

11) Open enrolment: This removed a fixed limit set by LEAs on each school's intake, allowing for school growth.

12) QCA: The Qualifications and Curriculum Authority.

13) SATs: (Standard Attainment Tasks) these are tests taken by pupils at the end of each Key Stage with the results reported to parents. The SATs measure the performance of pupils in the Core subjects based on a set programme of study divided into level descriptions. Once compiled, the data produced allows schools to be compared. Key Stage 3 National curriculum tests have been made non-statutory in maths and English after problems with marking in 2008. In 2009 most schools ordered the material produced by the QCA. The debate continues in England, at the time of writing, as to their future; but the trend seems to be towards a gradual reduction in their use, though that may change. Whether they have contributed towards a democratisation of the classroom remains unanswered.

GLOSSARY OF TERMS AND CONCEPTS RELATED TO EDUCATION IN WALES

1) Awdurdod Cymwysterau, Cwricwlwm ac Asesu Cymru (ACCAC) the Qualifications, Curriculum and Assessment Authority for Wales at the time of writing. Previously known as The Curriculum Council for Wales (CCW) a statutory body established in August 1988 under the Education Reform Act 1988.

2) Codeswitching: Estyn has written a consultation paper on this theme under a more local heading, dual literacy. The paper refers to the many aspects of teaching using two languages, sometimes referred to as trans-languaging, from considered translation work to teaching in one language whilst using resources in another. The paper also includes strategies for managing mixed language classes. Examples of classroom practice include using dictionaries to introduce Welsh terms.

3) Core subjects: Following the revised National curriculum for Wales these subjects include English, Welsh, mathematics, science and physical education and are compulsory for pupils from age 5 to 16. Pupils aged 5 to 7 years in Welsh speaking classes are exempt from English.

4) Cwricwlwm Cymreig (CC): This was the development of a Welsh dimension in the National Curriculum orders of each subject.

5) CYDAG: Cymdeithas Ysgolion dros Addysg Gymraeg., (The Association of Schools for Welsh Education).

6) Cymuned is a pressure group concerned with housing, education, language and work in rural areas of Wales that was formed in the summer of 2001.

7) Daugherty Commission, 2004 proposed that Key stage testing should be phased out by 2008, initially by making it optional and increasing the emphasis on teacher assessment. The commission recommended the replacement of key stage two tests with a "skills test" to be taken a year earlier in primary school.

8) Estyn: The body responsible for inspecting Welsh schools.

9) Foundation subjects: These are subjects other than the core subjects (English, Welsh, Maths, and Science in Wales), and form part of the structure of the National Curriculum. They are not compulsory from age 14 and include,

technology, history, geography, art, music and a modern foreign language for pupils aged 11 to 14.

10) Grant Maintained (GM) Status or Opting out: In Wales the take up of the policy was low. This is not to say, however, it did not have influence. Schools were able to use it as a bargaining position in order to abstain from coordinated LEA language policies.

11) Local Education Authorities (LEAs): These underwent a reorganisation in Wales in 1996 when the counties of Wales were, on the whole, divided into much smaller Unitary Authorities. Many of these smaller authorities adopted the linguistic policies previously developed by the disbanded larger LEAs.

12) Parent lobby groups:

   a. RHAG Rhieni Dros Addysg Gymraeg (Parents for Welsh medium education) were active across many areas; arranging open public meetings to discuss Welsh medium Education and pressing for new arrangements.

   b. Education First was a group of parents campaigning to choose schools other than their local school. Affairs often centred on transport costs outside catchment areas.

13) Popular schools initiative (PSI): This was implemented in 1995. John Redwood, the then Welsh Secretary, made £23,000,000 available to schools in order to expand. Schools were required to bid for the right to borrow the money. They were allowed to do so independently or via their LEAs. On the whole, the impact of this change in funding has been disregarded in Wales.

14) SATs: (Standard Attainment Tasks): In Wales, the Welsh Assembly stopped the KS1 tests and the publishing of performance tables. Testing, however, remained on the school agenda at the other Key Stages for a while.

15) SMP: The Schools' Mathematics Project. This was an individualised teaching scheme aimed at mixed ability classes, which was translated into Welsh. The scheme was revised in the late 1990s to reflect demands for more whole class teaching. The Welsh versions were not updated. SMP became associated with the uniform practice of mixed ability teaching in the lower years of secondary schools, which managed the sharing of pupils.

16) Welsh medium schools: In common with traditional Welsh schools, these are schools where Welsh is a core subject and therefore, in principle, Welsh possesses the same status as English, Mathematics and Science. To achieve designated status, however, schools have to teach more than half the subjects through the medium of Welsh, Daugherty and Elfed-Owens (2003). As traditional bilingual schools have become providers of various forms of Welsh medium education, designated schools have become less distinctive.

17) Welsh Baccalaureate: This was trialled across a small but increasing number of Welsh secondary schools by the Welsh Assembly Government (WAG) from 2001 onwards. It broadened the curriculum at KS5 and therefore contributed towards increasing the occupancy of each school, but not necessarily by increasing pupil numbers from new sources.

18) Welsh Language Board (WLB) formed in 1993 as a result of the passing of the Welsh language Act: This body was delegated responsibility for matters concerning the Welsh language. Funding for Welsh language/medium education increased steadily during this period. Public bodies were required to submit language schemes to the WLB and demonstrate how, under the terms of the Act, they were treating Welsh and English "on a basis of equality". In the late 1990s the Board accepted language schemes in education based on dualism (being communitarian in rural areas and creating alternatives in urban areas)

TRANSCRIPTION CONVENTIONS/CONFENSIYNAU TRAWSGRIFIADAU

Welsh Medium or Bilingual Lessons/ Gwersi Cyfrwng Cymraeg neu Dwyieithog

Font: Times

Italics: English language

English Medium Lessons/ Gwersi Saesneg

Font: Times

Italics: Welsh language/ Yr iaith Gymraeg

Symbols/Symbolau

A1, A2, B1, B2, C1, C2, C3, C4:   Teacher/Athro

P: Pupil/Disgybl

Ps: More than one pupil/Mwy nag un disgybl

P1, P2, P3... : Identified individual pupil/ Disgybl wedi ei adnabod

S1, S2: Support Staff/ Staff cynorthwyol

Additional Notes

1. Nid wyf wedi nodi gyda symbolau unrhyw thonyddiaeth gwahanol nac unrhyw oedi yn y trawsgrifiadau

   I have not indicated prosodic features including stress and intonation in these transcripts, neither have I indicated the duration of pauses in speech.

2. Rwyf wedi nodi ar y trawsgrif [inaudible] neu [unclear] lle roedd yn anodd i ddilyn y sgwrs.

   I have inserted [inaudible] or [unclear] where words or passages are incomprehensible.

Ar adegau yr wyf wedi nodi pryd mae'r athro yn cyfeirio at y dosbarth cyfan neu ddim.

At times I have noted on the text when a teacher is addressing the whole class or not.

[=   *Overlap*/Gorgyffwrdd

? =   *Obvious question/*Cwestiwn amlwg

CHAPTER 1
INTRODUCTION

1.1 Introduction

In the latter part of the 20th century education policy making and implementation in the UK was enveloped in a discourse relating to educational change. The call for change was disseminated by groups on the right of the political spectrum. The hitherto consensual nature of educational politics was disrupted by discourses that stressed the rights of parents. The emergence of those discourses (expressed in terms of entitlement to choice and diversity) was accompanied by a significant fall in demand (Carroll and Walford, 1997) a trend that is set to continue in Wales (Howson, 2003). And, at the same time, many working in the education sector were encountering a discourse characterised by a focus on educational markets, a language that was extraneous to the sector. This trend is captured in Fitz and Gorard's (2000) synopsis of national debates.

In that synopsis, Fitz and Gorard highlighted the controversy that exists in the research literature between those espousing the merits of a quasi-market and thus claiming to improve opportunities for the poor (a predominantly American position), and those who have concentrated on critiquing the market system by pointing out negative features such as its polarizing effect (a predominantly UK wide position). The political discourse in Wales, as part of the UK, has been influenced by the latter with talk of needs-based equity (Gerwitz, Ball and Bowe, 1995).

These discourses about educational change provided the starting point for my study. As an educational practitioner who has been directly involved in efforts to consolidate and develop Welsh-medium education at secondary level, I have become increasingly aware of the impact of wider political and discursive changes on local language policy developments. My concerns have been specifically with the teaching and learning of mathematics through the medium of Welsh, that is, with a subject that has, historically, been taught primarily through the medium of English. Over the years, I have been involved in local debates, in several different rural settings in Wales, about how Welsh-medium and bilingual provision for the teaching and learning of mathematics might be organised and supported. Through this experience, it has become clear to me

that the constraints that my colleagues and I faced and the issues that arose in local debates need to be understood with reference to the wider context of language policy and planning in Wales and, at the same time, to the far reaching changes that have been taking place within the educational system as a whole. These changes include the shift towards marketization of education, the increasing prevalence of discourses about choice and diversity and the development of new forms of educational governance in the pre and post-devolution era in Wales.

My concern with these dimensions of change in education, and with their specific impact on the development of Welsh-medium and bilingual education, led me to the research that forms the basis of this study. I wanted to stand back from the debates in which I was involved and to deepen my understanding of the current constraints on the development of Welsh medium education at secondary level. After reading some of the literature presented in chapter 2, I decided to do this by carrying out a detailed study of language policy implementation and classroom practice in several rural secondary schools in North and West Wales. I also decided to focus on one area of the curriculum, namely mathematics, the area of the curriculum with which I was most familiar.

1.2   *The Dimensions of the Study*

This study presents an analysis of discursive practices at three different levels concerning the development of Welsh-medium and bilingual education: at national level (within the nation of Wales), at local level (within local educational authorities) and at school level. Specific attention is also paid to the rural secondary school context. The study draws on my own experiences of developments following two major policy shifts: (1) the introduction of the 1988 Education Reform Act (ERA) and subsequent Acts, which were the main drivers of educational reform across the UK and (2) the influence of Welsh language policies and schemes prepared by Local Education Authorities (LEAs) before and after the Welsh Language Act of 1993 (see Chapters 4 and 5 for details).

When I began this study, the process of developing Welsh-medium and bilingual secondary education had been well underway for over fifty years. However, this process was far from complete. Some schools were quite advanced in their development; others were just beginning to accommodate demand. Other schools offered a mix of English and

Welsh medium instruction initially, but with Welsh being confined mainly to the humanities. The most advanced schools had almost entirely filled the gaps in their Welsh medium provision by as early as 1989. Some pupils in Wales, albeit a minority, were experiencing virtually all their education through the medium of Welsh. A significant number of those schools were in South Wales where many of the students were second language learners. In contrast, the provision for students with Welsh first language backgrounds in schools in rural Welsh–speaking areas of Wales was more uneven.

Within this context of expanding, but uneven Welsh language provision, my concern was to map out the different macro-processes of change impinging on the continued development and consolidation of Welsh-medium secondary education in rural areas of Wales and to investigate the interaction between these macro-processes, that is, the UK-wide educational reforms, language policies and language legislation relating to Wales and local conditions for the development of Welsh medium provision for mathematics. I also wanted to gain insights into teachers' understanding of these far reaching changes and into the ways in which the new forms of bilingual and Welsh medium provision were shaping classroom practice and patterns of communication between teachers and their pupils.

1.3   *Research questions*

These concerns led to the posing of the following questions, which were pitched at different levels of policy-making and classroom practice:

1) What has been the impact of the education reforms at the national and local level?
2) How have language policy developments at the national, regional and school level affected the teaching of Welsh medium mathematics?
3) What interactional practices emerge when different arrangements are made for Welsh medium mathematics?
4) How similar are these interactional practices across different types of classes?

1.4   The significance of the study

This study can be considered to be an addition to an emerging body of educational research related to the teaching and learning of mathematics in Wales. This research has gradually evolved to include more data collection on interaction in different mathematics classroom situations. However, as far as I am aware, there has been no study to date that combines research on interactions in classrooms situations with the study of macro-processes of change in educational policy and in language policy. The study presented in this thesis is the first of this kind.

In his informative compendium of qualitative research in education, Freebody (2004) gives an account of the background to the study of classroom interaction, and refers to a range of observable patterns of teacher-student interaction. These interactions range from those that are heavily dependent on teacher-directedness, said by some to impose significant constraints on pupils through closed questioning, to interactions that reflect a less authoritative style of teaching, which emphasises the significant role that social interaction plays in learning. These different patterns of interaction have been observable in mathematics classrooms throughout the period of education reform in Wales. Indeed, the requirements of the General Certificate of Education (GCSE) in mathematics have encouraged teachers to utilize different pedagogical strategies with their pupils whilst also preparing them for examinations. I will proceed by providing a brief genealogy of some important research in the field of mathematics in Wales, most of which took account of the bilingual context.

Some projects, such as those by researchers at the School of Education University of Wales, Swansea, (Tanner & Jones 1991/92) have focused on ways of developing metacognitive skills. They have looked at introducing modelling strategies, along with cross-curricular and group work, and therefore discussion, into the mathematics classroom. Tanner and Jones' initial study involved the trialling of different mathematical investigations by teachers in a cross-section of secondary schools in Wales and included collecting, and then analysing, those teachers' evaluations of how the lessons had progressed, as well as looking at the material produced by the pupils.

The research identified six different teaching strategies adopted by the teachers, according to their personal teaching philosophy, although the authors reported that some

teachers were flexible and used more than one approach. I include those different strategies below since they capture quite well a range of approaches to mathematics teaching:

1) Sink or Swim

2) Cookbook modelling

3) Questioning using organizational prompts

4) Internalization of scientific argument

5) Start stop go

6) Using peer and self assessment to encourage reflection

Tanner& Jones, (1991/92)

The conclusions of this project are cited below. They give some indication of educational priorities at that time. Tanner and Jones (1991/92) clearly attend to the concerns of different stakeholders in the project:

> The metacognitive skills of planning, monitoring and evaluating are integral to successful modelling. Learning can be viewed as both a process of cognitive construction and as a process of acculturation. Learning to model involves socialization into the consensual realities of a wider mathematical culture and the teacher plays a pivotal role in the generation of this consensus through the legitimization of linguistically expressed subjectivities. Assessment is an integral part of this process. Participation in peer and self-assessment involves the student in a recursive, self- referential learning process which supports the explicit development of metacognitive skills.
>
> Tanner & Jones (1991/92)

Tanner and Jones stress the social interaction considered necessary for more complete mathematical development and these are to be found mainly in strategies four, five and six above. This project, although comprehensive, did not audio-record or analyse the interactions in the classroom, and therefore may have missed some of the ways in which classroom talk contributed to knowledge-building and in the construction of classroom relationships.

In seeking to broaden the constraints on the range of planning and evaluative processes which pupils were allowed to experience during mathematical exercises, the approach advocated by Tanner and Jones (1991/92) could be described as part of a movement for a democratization of learning situations. The project encouraged more active pupil participation. This has been a feature of progressive teaching strategies since

the 1960s. In some ways, the project resembled another, more widely disseminated, curriculum development scheme called Cognitive Acceleration in Mathematics in Education (CAME) aimed at higher ability pupils, usually in year 7 and 8 of secondary schools, which has attained UK-wide recognition. Such projects appear to be the antithesis of much educational practice outlined by Freebody (2003: 94).

Some more recent studies in Wales have focused on the bilingual nature of interactions during mathematics lessons in primary and secondary schools and have been concerned with how teachers manage the interactional order in the classroom, whilst trying to accommodate children with different levels of ability in Welsh. Jones (1997); Pike (2004); Jones and Martin-Jones (2004). This body of work has drawn attention to the complexity and multifunctionality of codeswitching in bilingual classroom contexts and to the insights that can be gleaned from the close study of such bilingual interactions: insights into both the limits and potential of bilingual teaching.

The most detailed classroom-based research on mathematical teaching and learning in Wales was conducted in Welsh-medium primary school contexts by Pike, (2004). Pike focuses on the theme of different learning strategies that are employed by teachers and demonstrates the continued reliance on patterns of classroom interaction comprising the Initiation, Response, Feedback (IRF) routine first identified in the work of Sinclair and Coulthard (1975). A detailed discussion of Sinclair and Coulthard's work can also be seen in Jones (1995), which draws attention to how the discourse practices that construct teacher domination and authority close off opportunities for pupils to converse; a practice which is also detrimental to those learning Welsh. Surveying the different types of classroom interaction recorded in the classrooms in his study, Pike highlighted some democratic interactions similar to those developed by teachers during Tanner and Jones' (1991/92) project mentioned above. In Pike's study, an example is given of a more democratic classroom approach than those specified by Tanner and Jones, which involved pupils creating their own mathematical questions through shared experience. Based on this and other collaborative strategies, he recommended that pedagogic practice should include elements of a more balanced conversational approach to learning.

Following on from the research mentioned above, this study adds to the growing awareness of how mathematics knowledge is being constructed in Welsh schools by looking closely at the ways that teachers and pupils interact in mathematics lessons in bilingual secondary school contexts in rural Wales, and it aims to build on the work of others committed to including pupils more centrally in the process of teaching and learning mathematics. However, this study is distinct from those already mentioned in that it also attempts to consider the ways in which the day to day talk, in Welsh and in English, that occurs in mathematics classrooms in secondary schools is shaped by political, legislative and discursive conditions beyond the classroom.

1.5   Outline of the dissertation

This study begins by considering the development of the field of Language Planning and makes clear at the outset that there are constraints on language planning and policy implementation processes. Chapter 2 outlines the concept and critique of Language Planning and presents a model of implementation as an example. The chapter ends by looking at approaches to doing research, which incorporate the voices of those directly affected by policies. Next, in chapter 3, I offer a synopsis of bilingual educational developments in Wales during the last century. I couple this synopsis with a consideration of the means by which Welsh medium and bilingual education have been supported and consolidated so that language shift and the decline in the overall numbers of first language users of Welsh are addressed.

At the beginning of chapter 4, I set out the background on education reform in the UK, which was accompanied by the processes of language planning in Wales. In order to adopt a clear theoretical stance on the changes ushered in by the education reforms of the late 1980s and 1990s, I turn to recent educational research. I look, in particular, at the research by Ball (1981) that contributed to the development of differentiation polarization theory. I then turn to look at developments in Wales arising from the education reforms of the 1990s. I give a detailed outline of the many different and inventive strategies that have been devised, by management at local level, government and schools to help schools overcome the impact of changes in the way that schools are funded.

In chapter 5, I concentrate on the specific arrangements for use of Welsh in the teaching of mathematics in secondary schools that were defined by the bilingual Welsh-medium education schemes adopted in the two local authority areas, which provide the focus of this study. I will show how these arrangements are ushering in new ways of linking schools. I also show that parity between Welsh medium and English medium classes in rural areas has not been sustained. Here I will focus on Key Stage three (KS3), that is the early years of secondary school.

In chapter 6, I move on to discuss, in some detail, my research methods. I note that I adopted a broadly eclectic approach, gathering data from many sources. This allowed me to investigate the range of issues I was interested in. In this chapter I show how the research unfolded over time. Firstly, I opted for a case study approach, building on my personal classroom and school management experience and conducting research in schools, similar to those I was already familiar with. Secondly, a broader range of different types of data was gathered, so as to achieve triangulation and, finally, the validity of my interpretations was checked by inviting others to look at the same data. In this chapter, I also give an account of how I addressed ethical considerations.

Chapter 7 to 9 deal in depth with the data collected. The data analysis presented builds on insight from earlier research conducted before embarking on this thesis. This earlier research involved critical discourse analysis, based on different kinds of texts: a text related to the standardization of Welsh, a text from the memoirs of three former education authority officials, and also a recording of a media debate on education in Wales and the various discourses produced within it. Completing this groundwork allowed me to gain greater insight into the wider political and discursive contexts in which the teachers in this study were working and led me to adopt a critical interpretive approach to the study of the interview and classroom interaction data I had gathered in the study. In chapter 7, I present an analysis of interviews conducted with the teachers and mathematics coordinators in the schools in the study in which they foreground the different socio-linguistic conditions in these schools. Chapter 8 includes an account of the classroom based research carried out in two of the schools. I also set out the findings of my analysis of selected episodes from the longer transcripts of classroom discourse. I first discuss the findings from my research in the two different schools before progressing to

drawing comparisons across schools., (Appendix 12 provides insight into the teachers' perspectives on the classroom data). Finally, chapter 9 presents the conclusions of the study and offers recommendations.

PART I THE RESEARCH CONTEXT FOR THE STUDY

CHAPTER 2

RESEARCH ON LANGUAGE PLANNING AND POLICY

2.1 Introduction

In this chapter I set out to explore the following questions: What are the origins of the field of Language Planning and Policy (LPP)? How were the purposes of this field defined? What view of social science was reflected in the early research? What alternative approaches have been developed since then and what epistemological and methodological shifts have there been in the field? Which of these traditions of research provide the most suitable approach to the research questions that I am addressing in this study?

2.2 Origins of LPP research and the original concept of 'language planning'

The LPP field of research originates in the mid-twentieth century at a time when new nation-states were coming into being in Africa and Asia. In the early years, the main focus was thus on post-colonial nation-building. Different frameworks were devised by different researchers (e.g. Fishman, Ferguson and Das Gupta, 1968; Rubin and Jernudd, 1971) for the investigation of language planning and policy processes. As the field developed, views diverged regarding the viability of top-down, governmental imposition of language policies. As Wright (2004: 74) has put it: "Language planning scholars stretched along a continuum from those who believed that a decision could be taken centrally and imposed top-down, through education, to those who began to wonder whether language practices could be influenced greatly at all".

In this early work, language planning at governmental level was represented as rational, technical processes of 'language status planning' and 'language corpus development'. Language-in-development issues were often linked to education, and sometimes they were even linked to economic goals like cost-benefit analysis and strategies for maximising economic growth. The main weakness of this approach, as noted by Ricento and Hornberger (1996: 406) was that this "rational model viewed complex sociocultural phenomena involving languages as manageable problems, amenable to study and solution within the parameters of normative science".

One early contributor to the LPP field, the Norwegian scholar Einar Haugen (1966), was involved in research on regional dialects and on minority languages. Drawing on insights from this research, he argued that the introduction of new language policies only succeed when there is also a bottom-up movement in favour of the new policies. In work such as this, we began to see the spread of ideas about language planning to a wider range of sociolinguistic settings and to broader equity issues within established nation-states. These ideas were taken up by scholars such as Fishman (1967; 1993) and Haugen (1966) working with minorities in the United States. In this work, language planning came to be seen as a set of measures that try to respond to concerns regarding the extent of fairness within a society, with regard to linguistic minorities and with regard to the distribution of linguistic resources. A society where there is an inequitable distribution of linguistic resources, where institutions prioritise one standard form of a language over other forms is often described as a situation of 'diglossia' (Fishman, 1967; 1993) and Eastman (1983). The diglossia model has long been a dominant model and, as G. Williams (1992) has pointed out, it is rooted in a structural functional view of social science.

2.3 A critical, historical-structural approach

The 1990s saw a major shift in research on language planning and policy. At the forefront of this shift were scholars such as Tollefson (1991, 1995, 2002), Phillipson (1992) and Skutnabb-Kangas and Phillipson (1994). In a landmark volume, Tollefson (1991) introduced a 'critical, historical-structural approach' to the study of language policy. He called for research which takes account of historical and ideological processes and of social structures in the construction of linguistic inequality. In his own words, "the major goal of policy research is to examine the historical basis of policies and to make explicit the mechanisms by which policy decisions serve or undermine particular political and economic interests" (Tollefson, 1991: 32).

Scholars working in this critical, historical vein were able to provide richer, more explanatory accounts of the processes involved in language policy making and they were able to show how these processes varied across social, cultural and political contexts. As Ricento and Hornberger (1996: 408) have observed, these new perspectives on language

policy were achieved "by locating the LPP enterprise within broader theories of sociology, economics and culture". Tollefson, for example, was one of the first authors to draw on critical theory (e.g. Habermas, 1985) and on post-structuralist thought (e.g. Bourdieu, 1991; Foucault, 1991). In a recent article (Tollefson, 2006: 43), he indicates what 'critical' means for him: he sees it as "research aimed at social change" and as "work influenced by critical theory". He goes on to explain that: "Critical theory highlights the concept of power, particularly in institutions such as schools, involved in reproducing inequality" (Ibid.)

Research within this critical tradition has been primarily concerned with the ways in which nation-states deal with multilingualism, with linguistic minorities and cultural difference. As Tollefson (2002) notes, there are two broad options open to nation-states: (1.) To repress differences, but in doing so to create seeds of future conflict and dispute; or (2.) to extend democratic pluralism. Regarding the second point, Tollefson has the following to say:

> "Extending democratic pluralism entails abolishing discrimination based upon ascribed social categories such as ethnicity and language, as well as reducing the social and political distance between ethnolinguistic groups created by excessive inequalities in the distribution of economic resources" (Tollefson, 2002: 335).

2.4 Taking account of the 'layers' of language planning and policy

In more recent writing on language planning and policy, there has been a critique of the exclusive focus on the 'macro'-level of policy making. The critique has been levelled at both the early research on language planning in post-colonial contexts and at critical, historical-structural approaches to language policy research in a broader range of contexts. While the value of critical, historical-structural approaches is widely acknowledged, there have been calls for more attention to be given to the specific ways in which LPP processes unfold at national, regional and institutional levels (e.g. Ricento and Hornberger, 1996).

Referring specifically to language policy processes in education, Ager (2003) points out that language planning is undertaken at every level of an education system. This includes central and local government, school policies, teacher values and practices

and the preferences of parents and individual pupils. At central and local governmental levels, language planning reflects the priorities of those who hold power and determines the distribution of resources, either material or symbolic. However, as language planning and policies move from the national level to the school and classroom level, they may be modified or used to deliver entirely different outcomes from those initially intended.

Ricento and Hornberger (1996) used an 'onion' metaphor to capture these different 'levels' or 'layers' of language planning and policy. For them, the 'unpeeling of the onion' meant investigating how "agents, levels and processes of LPP - permeate and interact with each other in multiple and complex ways" (1996: 419). Referring to language-in-education policy, they indicated that they saw teachers, in local classrooms as being crucial to language planning and policy processes. As they put it: "We place the classroom practitioner at the heart of language policy (at the center of the onion)" (1996: 417).

2.5 School and classroom-based ethnography in LPP contexts

The recasting of LPP as a "multilayered construct" (e.g. Ricento and Hornberger, 1996) led to the development of ethnographic approaches to research on language policy processes in educational settings. The main aim in this research is to move closer to the action in local classrooms where policies are being introduced (or reproduced) and to gather first hand data through ethnographic methods, such as participant observation and ethnographic interviews. The rationale for this methodological shift has been that it allows researchers to interpret and analyse with greater certainty the responses of teachers and students to language policy developments.

This shift towards detailed interpretive research, away from the positivist epistemology associated with the early research on language planning, was part of a more general trend. Thus, even though Cooper (1989) was part of the structural functional tradition of language planning research, he anticipated the need for more detailed qualitative research. He called for more case studies of language planning at every level rather than just descriptions and analysis of macro-level planning.

Ethnographic work on language planning and policy has been in the ascendancy since the 1990s. There have been two overlapping strands of research: the first strand

combined ethnography with close analysis of bilingual classroom discourse and embraced critical, post-structuralist and post-modern perspectives from the wider social sciences. It was developed in a range of contexts: in post-colonial settings, such as those where interest in LPP research was first ignited (e.g. Martin, 2003); in multilingual urban settings in the countries of the global north (e.g. Martin-Jones and Saxena, 1996, 2003; Blackledge and Creese, 2010); and in contexts, such as the one in Wales in this study, where bilingual education had been introduced as a response to language movements (e.g. Heller, 1999, in French Canada; and Jaffe, 2003, in Corsica). Because of the focus on bilingual discourse, this strand of research was not, initially categorised as being part of the field of 'Language Planning and Policy (LPP)'. The main concern was with developing a critical approach to bilingual classroom processes: to connect local situated practices and the analysis of classroom interaction to wider discourses about language and to the more general role of schooling in society. As Martin-Jones (2007) has put it:

> "The main theory-building strategy was to focus on two main ways in which schools operate as institutions linked to the state: firstly, the ways in which schools serve as spaces within which specific languages (national, official languages) and specific linguistic practices (ways of speaking, reading and writing) come to be inculcated with legitimacy and authority; secondly, the ways in which schools function as spaces for selecting and categorizing students, for assessing performance (including linguistic performance) and providing credentials which are ultimately tied to positioning within the world of work" (Martin-Jones, 2007: 172).

The work of the post-structuralist scholar, Pierre Bourdieu (1991), proved to be a useful resource in taking this theory-building forward, particularly his notion of 'legitimate language'. Bourdieu saw education as a key site for social and cultural production and reproduction and for the imposition of a particular symbolic order. However, in this first strand of ethnographic research in multilingual classroom settings, the empirical starting point was with the fluid and complex nature of interactions in schools and classrooms. The study of the interactional order was then linked to the wider social and symbolic order.

The second strand of ethnographic research developed later was the first to come to be known as 'ethnography of language policy'. It emerged in different contexts in the

United States where major changes were taking place at the federal and state level and where long established bilingual education programmes were being replaced with programmes that prioritised the learning of English as a Second Language. The article by Ricento and Hornberger (1996), already mentioned above, on 'unpeeling the policy onion', was at the forefront of this shift to ethnography in the LPP field. It was followed by other significant calls for the development of multilayered ethnographic approaches to language policy processes (e.g. Hornberger and Johnson, 2007; Johnson, 2009; McCarty, 2011; Hult, 2010). Hornberger and Johnson (2007) extended the onion metaphor, arguing that researchers in this field should be 'slicing the onion ethnographically'. They described, as follows, the particular contribution that ethnographic research on language-in-education policy can make, complementing critical, historical approaches:

> An ethnography of language policy can include textual and historical analyses of policy texts but must be based in an ethnographic understanding of some local context. The texts are nothing without the human agents who act as interpretive conduits between the language policy levels (of layers of the LPP onion)"
> Hornberger and Johnson, (2007: 528)

Hornberger and Johnson (2007), and other scholars (e.g. Menken and García, 2010) have put particular emphasis on teacher agency (even in adverse policy conditions), on teachers' understandings of policies and on the way these understandings guide their classroom practices.

2.6 The approach to LPP research adopted in this study

In this study of the teaching and learning of mathematics in bilingual secondary schools in rural Wales, I have adopted a critical ethnographic approach to language planning and policy, taking account of different 'layers' and 'spaces' for policy interpretation and implementation. Methodologically, my main focus has been on interpretation and analysis of audio-recordings of classroom talk and of consecutive interviews with teachers. In carrying out this work, I have been mindful of the fact that the study of classroom interaction involves methods that emphasise the particular rather than the general. In order to gain greater understanding, interpretive work of this kind is grounded in the study of everyday lives, through ethnography, and in the analysis of

interaction and everyday classroom routines. However, in keeping with the first strand of ethnographic research described above, I have also attempted to show some of the ways in which interactions in the classrooms in my study contributed to the construction of the wider institutional order within the schools where I was working.

In adopting this approach, I have found that one particular aspect of the research by two scholars in particular, Martin (2003) in Brunei and Jaffe (2003) in Corsica is particularly relevant to my study: that is, their analyses of talk around texts, including texts on the blackboard, in textbooks or in material prepared by teachers. These scholars showed how interactions of this kind contributed to the construction of language values as teachers attempted to mediate texts in either the dominant or minority language. As I will show later, in the data analysis chapters of this thesis, the patterns of classroom interaction described by Martin (2003) and Jaffe (2003), in classrooms of a very different kind, actually bore a resemblance to some events in my study.

Critical ethnographic research, combined with analysis of bilingual classroom discourse has the potential to reveal the disparities that can exist between formally-adopted policy and actual practice in the classroom. It can also draw attention to the predicament of those who need more access to teaching/learning resources and whose own linguistic resources are capable of being developed further by schools. This kind of bilingual education research is insufficiently developed in the Welsh context. I will return to and elaborate on this point in Chapter 10. Similar calls for critical and interpretive research are being made in other, closely related areas of educational research in Wales (e.g. recent work in Policy Sociology). Take, for example, the research agenda delineated by Phillips and Sanders (2000): Referring specifically to the teaching of Welsh, they argue that: "Work of a critical, analytically informed nature is needed to explore how these meso and school cultural/political struggles are taking shape" (Phillips and Sanders, 2000:18).

The other key aspect of my work is that it focuses on the teaching and learning of mathematics in bilingual schools. Critical ethnographic research on the teaching and learning of mathematics in multilingual settings is still at a very early stage of development, despite pioneering work by researchers such as Barwell (2005, 2008, 2009) and Setati (2005). There have been recent moves by researchers in this field to share

perspectives across cultural and historical contexts. Take, for example, Study Conference 21 organised in Brazil, in September 2011, by the International Commission for Mathematical Instruction. However, there is still relatively little published work in this area. The aim of this study in Wales is to make a contribution to this embryonic field and to complement qualitative studies already undertaken in Wales, such as those mentioned in Chapter 1 (e.g. Tanner and Jones, 1991/1992; Jones 1997 and Pike, 2004).

2.7 Chapter summary

This chapter has reviewed the literature on language planning and policy (LPP), tracing different shifts in epistemology and methodology and considering the different political and historical contexts in which research has been undertaken. I touched on three broad traditions of research in this area: (1.) The early work which was largely based in post-colonial settings and which focused almost entirely on language planning, language policy and language legislation at the level of the nation-state. In this first body of research, language planning was seen as a rational, technical activity and research methodology was mostly informed by a positivist approach to social science., (2.) A critical, historical-structural approach which started from a critique of the ways in which language planning and policy was represented in the early research. This second tradition incorporated perspectives from critical theory and from post-structuralism and provided much richer and explanatory accounts of language policy processes., (3.) A third tradition which drew attention to the multi-layered nature of LPP processes and which demonstrated the need for a methodological shift to case study work and ethnography. I identified two strands of work within this tradition: a first strand, emerging in the late 1990s, which started from close analysis of bilingual discourse practices in classrooms and which sought to explain why these practices were the way they were. This research was carried out in a wide range of contexts: in post-colonial settings, in multilingual urban schools and in minority language contexts. The second, and more recent strand of research, came to be known more explicitly as 'ethnography of language policy' and was first developed in different contexts in the United States.

PART II THE EDUCATIONAL CONTEXT OF THE STUDY

CHAPTER 3

LANGUAGE-IN-EDUCATION PLANNING AND POLICY IN WALES

3.1   Introduction

In this chapter, I turn to language planning and policy developments in the specific educational context for this study: that of Wales and the development of Welsh-medium and bilingual education. I will provide a brief historical overview of key developments in language-in-education policy in Wales. More detailed analyses of these developments are already available (e.g. Baker, 1990; Bellin, 1995; Baker and Jones 2000; C.H. Williams, 2000; Jones and Martin-Jones, 2004).

Section 3.2 presents a sketch of the early developments from the 1960s to the 1980s. Section 3.3 provides examples of the ways in which the new forms of bilingual and Welsh-medium education were consolidated. Section 3.4 touches on some of the ways in which the UK-wide education legislation of the 1980s had an impact on education in Wales. I look at these issues again in more detail in Chapter 4. In section 3.5, I discuss the Welsh Language Act of 1993 and post devolution policy developments. Section 3.6 notes the contrast between national and local perspectives on current policies and draws attention to the challenges involved in policy implementation at local authority level (LEA, school and classroom level. Section 3.7 looks briefly at recent guidelines regarding classroom language use put forward by Estyn (the Welsh inspectorate). Section 3.8 presents a brief chapter summary.

3.2   A brief overview of language policy development

Up to the 1960s the dominant discourse in Wales represented bilingualism as a 'problem' rather than a national resource. The space provided for Welsh in education was, on the whole, curtailed. However, by the mid-1960s, changes were already visible in official discourses. C. Williams (2003: 261) draws attention to a meeting at the Welsh Education Office, either in November 1964 or 1965 (both dates appear in the original text), where two principles were apparently accepted:

"the establishment of more Welsh-medium secondary schools in the Anglicised urban areas, and the strengthening of the position of the Welsh language in schools within traditional Welsh-speaking areas."

<div align="right">C. Williams, (2003: 261)</div>

This major shift in official discourses about Welsh was the outcome of a language movement that had unfolded over several decades prior to the 1960s and that had called for change in the status of Welsh in different domains of social life, including education, the media and the legal system. The 1960s saw the first legislative and policy responses to grassroots demands, including the Welsh Language Act of 1967 (largely pertaining to use of Welsh in the law courts) and the significant changes in educational policy.

By the mid 1970s, a succession of new bilingual and Welsh medium schools, both primary and secondary, usually in urban areas, were established, though not without controversy. The process continued throughout the next decades aided by significant enhancements to funding (C. H. Williams, 2000: 31). The process of expansion, however, was said to falter at the turn of the millennium with a change of emphasis at the heart of education policy in Wales.

Parental demand played a key role in the establishment of Welsh-medium nursery schools and primary schools. In 1971, a national organisation called *Mudiad Ysgolion Meithrin* (The Welsh Nursery Schools Movement) was established (Baker and Jones, 2000). The successful campaigning of this organisation led to increasing demand for Welsh-medium primary schooling, especially in the anglicized areas of Wales, such as the south and the east. Other national organisations were also founded in this period and were able to work across the different LEAs in Wales. Take, for example, *Undeb Cenedlaethol Athrawon Cymru* (The National Union of Teachers of Wales).

While parental demand was a key factor in the development of Welsh-medium and bilingual schools, at the secondary level, particular LEAs led the way (Bellin, 1984). The first two bilingual schools- *Ysgol Glan Clwyd* (1956) and *Ysgol Maes Garmon* (1961) were established in the former county of Flintshire in North East Wales. Then, in 1962, Glamorgan LEA opened the first bilingual secondary school in South Wales in a largely English-speaking area. Baker (1993:81) has referred to these initiatives as "the beginning of institutional change in secondary education".

As Welsh-medium and bilingual education became a significant part of statutory provision in Wales, there was increased institutional support and, as indicated above, increased funding. The institutional support came from bodies such as the School Inspectorate (Her Majesty's Inspectors for Education in Wales-HMI Wales-which is now known as Estyn), the Schools Council in Wales, the Welsh Joint Education Committee (the examination board) and teacher training institutions. It also came from individuals and local groups, parents' groups, local teachers and head teachers and some local authority advisors.

Two types of bilingual schools gradually emerged: (1) 'designated bilingual schools', which were established largely in anglicized urban areas of Wales, as an alternative to local English-medium provision; (2) 'traditional bilingual schools', which were, for the most part, located in rural areas where Welsh was widely spoken.

3.3   Consolidation of Welsh medium and Bilingual education

Practical measures were being employed to support, sustain and consolidate the fledgling Welsh medium schools, and in particular the children from wide-ranging backgrounds who were taking advantage of the new provision in schooling. It is these practical measures, which I now wish to outline. Some have been piecemeal measures, others have been more coordinated. There are differing views on the extent to which they dealt with the core concern of addressing the need to improve the bilingualism of all pupils.

At the national level, a high status source of support was supplied from 1981 onwards by the Welsh television channel S4C. This channel broadcast many educational and entertainment programmes. Local language revitalization schemes are described by Campbell (1993) and Jones (1995:103-105). These were practical initiatives that encouraged the use of Welsh in local community contexts. Alongside these, by now, well-established schemes there has been research exploring ways in which Welsh speakers can be supported in the use of Welsh across a wide range of domains (Reid, 1993 and Jones, 1993) there have also been moves towards advocating the 'marketing' of minority languages in new domains (Jones & Dafis, 1993).

In publishing, there was a drive towards standardizing the terminology to be used in Welsh medium classrooms. Teachers of mathematics, for example, had access to terms that accompanied translated schemes. A small handbook for mathematics and physics teachers was available in the late 1980s. The Modern Welsh dictionary, Evans (1982,1992) was followed by comprehensive works such as: The Welsh Academy English-Welsh Dictionary (1995), but more specifically by" Y Termiadur Ysgol" (1998) (Standardized terminology for the schools of Wales) commissioned by the Qualifications, Curriculum and Assessment Authority for Wales (ACCAC), and produced by the Centre for Standardizing Terminology, University of Wales, Bangor. This 'Termiadur' was subsequently revised in 2006 to meet the enhanced Welsh medium curriculum in vocational and A level subjects. Previously, teachers needing this kind of support relied on their own unpublished lists, as the authors of the "Y Termiadur Ysgol" pointed out.

The rationale for this standardization is set out in the preface to the " Y Termiadur Ysgol". There it states:

" Standardization is necessary in order to make sure that the same technical terms are understood by pupils throughout Wales, and to ensure consistency across all key stages and between all subjects in the National Curriculum."

Prys and Jones, (1998)

Further attempts to consolidate Welsh medium education saw considerable growth in the production of translated curriculum materials. A steady stream of mathematics books were made available in Welsh in both primary and secondary levels from the 1980s onwards. At secondary level, for example, there was the individualised teaching scheme by the School Mathematics Project (SMP) and this was followed by a more traditional teacher centred set of course-books by Vickers (1992) called *National Curriculum Mathematics*. Other books in the 11 to 18 age range followed. Translated material for other subjects, however, lagged behind the mathematics output.

3.4   The UK-wide educational legislation of the 1980s: the impact on Wales

As I will show in more detail in Chapter 4, the 1980s saw the reorganisation of education in England and Wales along market lines. The 1980 Education Act provided increased support for parental choice. In Wales, this worked in favour of parental demand for Welsh-medium education. The 1986 Education Act gave head teachers and school governing bodies greater autonomy from LEAs and shifted greater budgetary control to schools. And, lastly, the Education Reform Act of 1988 established a National Curriculum. Under the terms of this curriculum in Wales, Welsh became a Core Subject, along with English, mathematics and science, in all Welsh-medium and bilingual schools.

3.5   Language legislation and political devolution

Continued campaigning around the status of the Welsh language eventually led to the passing of the Welsh Language Act of 1993. This Act provided a statutory framework for the treatment of Welsh and English "on a basis of equality" in public sector institutions in Wales. Under the terms of the Act, the Welsh Language Board was charged with the responsibility of ensuring compliance, across all public sector institutions in Wales. From then onwards, institutions such as schools, LEAs and universities were required to submit 'language schemes' to the board, demonstrating how they were planning to provide equal support for Welsh and English. Another key role of the board was that of "maintaining a strategic overview of Welsh-medium education" (C.H. Williams, 2000).

At the end of the twentieth century, political devolution brought new policy developments. *Cynulliad Cenedlaethol Cymru* (The National Assembly for Wales) was founded in May 1999. Within its first few years, the Welsh Assembly Government was actively engaged in the formulation of new policy statements on language. *Dyfodol Dwyieithog* (Bilingual Future) was the first main policy document to appear. This set out the Welsh Assembly Government's vision (WAG, 2002:4), in the following terms: "in a truly bilingual Wales, both Welsh and English will flourish and be treated as equal". This policy statement was followed by the publication of a

National Action Plan, called *Iaith Pawb* (Everyone's language) (WAG, 2003). Among the goals set out in Iaith Pawb were to:

1) Increase the proportion of Welsh speakers by 5% by 2011
2) Arrest decline in heartland communities especially those with close to 70%+ Welsh speakers
3) Increase the proportion of children in pre school Welsh education
4) Increase the proportion of families where Welsh is the principal language
5) Mainstream Welsh medium services

(WAG, 2003)

Much emphasis was placed in this document on increasing the number of speakers of Welsh. It is still too soon to judge the impact of such commitment to action.

Further policy moves came in 2007, during a brief period of coalition government in Wales, involving the Welsh Labour Party and *Plaid Cymru* (The Party of Wales, formerly the Welsh Nationalist Party). In a new policy document, *Cymru'n Un* (One Wales) (WAG, 2007a), this government made a commitment to a review of all Welsh-medium education and to the development of a new strategy and implementation plan. The strategy was published in May 2009, but there was a change of government in 2010 during the period of consultation that followed. The outcome of this process remains unclear. In the meantime, the Welsh Government has now acquired enhanced legislative powers, in particular devolved areas of Government. These include the development of policy with regard to the Welsh language.

3.6   The national and local levels of language planning and policy

As the legislative and policy changes take place at national level in Wales, the most pressing language-in-education policy issues are played out at LEA and school level. When viewed from a national perspective, there have been significant gains in bilingual and Welsh-medium provision. According to statistics gathered by the Welsh Assembly Government (2007b) for the 2006/7 school year, 30.5 per cent of all primary schools in Wales, and 24 per cent of all secondary schools, were offering more than half of the curriculum through the medium of Welsh. In addition, pupils in all schools in Wales were required to study Welsh, as first or second language, for 11 years (from age 5

to 16) (WAG, 2007a). Equally striking is the statistic that from 1989/90 to 2008/09 the number of secondary schools describing themselves as Welsh medium (where more than half of foundation subjects other than Welsh, English and Religious Education are taught wholly or partly in Welsh) rose from 42 to 55 and the corresponding number of pupils rose from 26,058 to 41,916, the latter being a 60 per cent increase in 20 years (Schools in Wales: General Statistics, 2009, Table 7.3).

However, when language policy is viewed from a more local level, particularly in the rural contexts that I am concerned with in this study, we see some of the challenges that arise in the implementation of language-in-education policies. Many traditional bilingual schools in rural areas are experiencing demographic changes, due to in-migration of English speakers into rural Wales. As a result, there has been significant change in sociolinguistic composition of school populations. Nevertheless, these schools have to cater for the needs of all their pupils. As I will show in Chapter 5, different schools and LEAs have attempted to deal with these challenges in different ways.

3.7   Language and literacy practices in the classroom: policy guidelines

The diverse linguistic needs of these various types of classes meant that different approaches were adopted and combined to manage them. Many of these approaches are discussed on the Estyn web site, the body responsible for school inspections in Wales. The approaches are grouped under the broad term "dual literacy". They are by now quite well established practices. Estyn's suggestion was that teachers in Welsh secondary schools should have a palette of teaching approaches to draw from. They include the following:

a)   Allowing the simultaneous use of Welsh and English textbooks

b)   Asking pupils to use English medium material where no equivalent Welsh material is available e.g. Websites, software, but asking pupils to report back, making an oral presentation, in Welsh.

c)   Reverting to English or alternatively Welsh to varying degrees, but usually at a more intimate one to one level., (Scaffolding through codeswitching)

d)   Switching from one language to the other when addressing children with differing language preferences and strengths., (Bilingual class).

e)   Introducing Welsh and English terms together.

It may appear from the above that there are, on paper or on screen, common teaching strands between the various types of classes, but as I will show in the data analysis chapters of this thesis, there are also fundamental differences depending on the local conditions, on the resources available to local schools and practitioners and on their language values and teaching styles.

The idea of "dual literacy" appears to have been adopted as a means of acknowledging the existing practice of codeswitching in many Welsh secondary schools. It is the only way in which the increasingly diverse intake in secondary mathematics classes (and in other areas of the curriculum) in Welsh medium and bilingual schools can be accommodated. Ideas such as 'dual literacy' have also surfaced in the literature on bilingual education in Wales (e.g. Roberts and Williams et al, 2003; Dodson, 1995; Estyn, 2002).

3.8   Chapter summary

In this chapter, I have provided a brief overview of language planning and policy developments in Wales over the last halfcentury. My account has dealt with different 'layers' and 'spaces' of policy–making. These include: (1.) UK-wide developments, including language legislation in 1967 and 1993 and the educational legislation of the Conservative government of the 1980s., (2.) National developments in Wales, starting from the Welsh language movement to the changing policy discourses of the 1960s and to the gradual establishment and consolidation of bilingual and Welsh-medium education, from the 1960s to the present., (3.) Post-devolution developments in language planning and policy in Wales., (4.) The challenges involved in language policy implementation at local level, particularly in schools in the rural areas of Wales., (5.) Recent guidelines from Estyn (the Welsh Inspectorate) regarding language and literacy practices at classroom level.

CHAPTER 4

EDUCATIONAL REFORM AND CURRICULUM CHANGE

4.1 Introduction

Handy's (1985) classic study of organisational theory and practice refers to the generic behaviour of organisations in times when demand is low. This behaviour tends to iron out diversity by a process of coalescing, or more specifically the elimination of differences.

According to Handy:

> "Organisations are inclined to manage the environment rather than respond to it
> and in that way to limit diversity and reduce uncertainty."

Handy, (1985:303)

In addition, he pointed out that there was also greater pressure for tight control.

Both of the above characteristics were observable in English and Welsh education initiatives during the 1980s and I use them as my framework in this chapter. This was a period that saw the removal of significant social arrangements between state institutions, as the policy of open enrolment and other school policies that encouraged school independence changed the significance of the school catchment area. In Wales, the growth of Welsh language teaching was the most significant change to the curriculum during the 1980s (Baker, 1990). The growth in Welsh medium and bilingual education also coincided with the drive for uniformity between schools in the context set out above, as did the Cwricwlwm Cymreig, which required some careful and sensitive defining to recognise local variations.

4.2 Factors behind the UK-wide Education Reforms of the 1990s

In order to appreciate the forces shaping the progress of reform, I want to begin this section by reviewing some of the discourses that were present prior to the series of reform acts implemented by successive Conservative Governments. The development of comprehensive education was mapped in Ball's (1981:1-21) ethnographic study of Beachside Comprehensive school. In that study, Ball drew a typology of comprehensive education emerging over a period from 1945 to the mid 1970s under the influence of both

Labour and Conservative Governments. Ball cited economic reasons as one motivation for the establishment of comprehensive schools and referred to two reports, Newsom and Robbins in 1963 (Under a Conservative Government) that contributed towards the general thrust particularly in rural areas. In addition, he cited the pressure accorded by circular 10/65 published by the Department for Education and Science (DES) as a determining factor for many authorities in re-organising educational provision. He pointed out that comprehensive education meant different things to different people and that the different traits could be present within the same school. For example, staff in different departments or at different stages of pupils' progression through the secondary school would hold conflicting views.

Comprehensive schools were described as operating under three different principles. The first is the Meritocratic principle, which was favoured by the National Association of Schoolmasters who were against the mixing of abilities in the same class. The second is the Integrative principle, which was based on a 'process' of social engineering in combination with the other two, and the third is the Egalitarian principle. Ball's discussion of the first type is interesting in that he divided meritocratic schools into two versions, the weak and the strong, both based around a discourse of equality of opportunity. Ball was dismissive of the weak version. He refers to: "bland statements about all children going to one school" from the same catchment area. He found the stronger version to be an amelioration of the bipartite system, with the dominant view being, "the selective system was good in terms of its aims, but that it was not operating adequately." He was most critical of the Egalitarian principle, and of schools where the principle was most frequently articulated. He said that:

> "The model assumes that the schools operate in a cultural vacuum and once given
> access to the school that the pupils will automatically achieve their 'full potential'.
> It ignores the factors of class and culture conflict and discontinuity that have been
> shown to be important in limiting the levels of achievement that children attain."

Ball, (1981:7)

This echoes the Bourdieuan argument that the discourses and practices of schools contribute to the reproduction of wider social relations of inequality.

Turning to the second type, the discourse about comprehensive schooling based on the Integration principle, Ball relied primarily on the discourse of Anthony Crosland, a prominent politician in the Labour Party in the 1950s. Crosland elevated the thinking that permeated the party about the eradication of social difference by emphasising tolerance. Ball pointed out that although this discourse included references to breaking down class barriers, with children mixing freely, Crosland hedged the position by favouring academic streaming. Ball also criticised research on Comprehensive Education during this period since it did not:

> "take into account the curriculum or the organization of the classroom as important factors to be changed in the process of reform."

> Ball, (1981: 8)

In addition, Ball ascribed less value to the first two types of schooling by stating they continued to exhibit the characteristics of Grammar schools by not being, "explicit about changes in the process of schooling." (Ibid)

The third type, Egalitarianism, was identified as having the potential to make a more meaningful impact on the structure and process of learning, although at the time there were few examples of this type. Ball showed, however, that the egalitarian project was incomplete. Practice in mixed ability classes continued to disadvantage and alienate a significant proportion of working class pupils who were under-represented in the higher levels of education. Nevertheless, the relevance and value of mixed ability teaching to the egalitarian project was emphasised by showing that it corresponded to each of the aims of comprehensive education articulated by those espousing different principles: the change in the internal structure of the educational system in ways that corresponded to egalitarianism, "the greatly increased possibilities for the achievement of the aims of social mixing and social tolerance" (Ibid) advocated by integrationists and the, "greater equality of opportunity" advocated by meritocratic supporters.

In the mid 1980s a change in the assessment system occurred with the introduction of the GCSE. This was a unified examination system with a greater emphasis on coursework and teacher assessment, which influenced classroom practice by broadening the criteria for success. Perhaps surprisingly, therefore, the "egalitarian" project

continued side by side with some of the liberalising reforms of the Conservative Governments of the 1980s.

4.3 Developments coinciding with Education Reform

The policies and issues related to education reform in the UK have been analysed and discussed extensively over the last two decades. This literature can be divided into two related themes. The first is concerned with taking control of the curriculum. Some of the matters related to control over the curriculum discussed over quite an extensive period of time included: cultural restorationism Ball (1994), differences between English and Welsh educational policies, and nation building in Wales, (Phillips & Daugherty, 2001). The second theme is concerned with the movement of pupils and funding across schools and this has received attention under the headings such as: markets, choice, devolution and autonomy (e.g. Gerwitz, Ball and Bowe, 1995). Critics have suggested that schools have been subjected to devolution of responsibility and accountability and have been given autonomy to implement cuts. Meanwhile, other commentators have concentrated on the "professional" response to the reforms with a discourse about partnership, collaboration, and anti-competitive behaviour, (e.g. Bridges & Husbands, 1996) I will begin with a short recap of the first theme along with a less orthodox view of its role.

4.3.1 Taking control of The Curriculum in Wales

The immediate response to the neo-liberal reforms of successive Conservative Governments during the 1980's was a move to develop a broad and balanced curriculum, which was considered an entitlement for all pupils. Of course, the nature of that curriculum was a matter of intense debate as outlined by Daugherty and Elfed-Owens (2003). The introduction in Wales of a Cwricwlwm Cymreig focusing mainly on introducing the use of Welsh into the school curriculum for pupils whose first language was Welsh, symbolised the will of established parts of the British State to take account of traditional values (Ball, 1994) within the wider project of rationalizing educational provision. This development also, satisfied the purpose of nation building in Wales in the run-up to political devolution at the end of the twentieth century (Phillips & Daugherty,

2001). According to Fitz (2000) the guidelines for the Cwricwlwm Cymreig represented " local interpretation of national frameworks". They could be interpreted as promoting and protecting "values" as state schools are downsized, values which would continue to differentiate between the roles of languages.

The development of the Cwricwlwm Cymreig, may have been a means of acknowledging, formalising and broadening existing inclusive practice in some Welsh schools. During the nineties, however, some schools differentiated themselves further from other schools by constructing their own interpretation of a Cwricwlwm Cymreig, whilst some commentators expressed concern that the policy was not widely appreciated or implemented amongst teachers, an observation confirmed by Jones (2003) drawing on reports made by the Inspectorate in Wales. The wider dissemination of aspects of the Cwricwlwm Cymreig was facilitated by the educational press in Wales, see Lewis (1998) in relation to Religious Education, Jones & Roberts (2000) in relation to Mathematics and subsequently W. L. Jones & L. Herbert-Egan, (2003) in relation to Anglo-Welsh literature and Jones (2003) for general aspects of the curriculum. A broader awareness of the Cwricwlwm Cymreig was made possible by these interventions.

4.3.2   School funding and partnerships.

The second theme is related to how schools coped with changes to their financing. The main change experienced by schools after the Education Reform Act was the direct link made between the resources allocated to a school and its pupil numbers. Pupils arrived at a school possessing a notional financial value, which was weighted for pupils with additional needs. Secondary schools across Wales have therefore intensified the closeness of their relationships with their partner primary schools. Pupils in the final year of primary schooling may experience significant levels of contact with a local secondary school. This contact might include visits from secondary school teachers to days spent at the secondary school experiencing curriculum taster lessons.

Other forms of partnering in Wales began at the local level and involved the sharing of curriculum knowledge, current practice and costs. Advice on implementing partnering was seen in the literature of Welsh teaching unions mainly in relation to

primary schools, as the primary sector of education was having to cope most immediately with a reduction in funding in line with fewer pupils. Partnering was fostered across secondary schools too, in every curriculum area. LEA advisors held frequent courses to disseminate national and local initiatives within a subject. This strategy coincided with apparently increased funding for school buildings which is illustrated by the passage below taken from the House of Commons Hansard Debates for 20 Dec 1988:

WALES

Welsh Language

Mr. Wigley : To ask the Secretary of State for Wales what steps he proposes to take to deal with lack of capacity in Welsh medium schools; and if he will make a statement.

Mr. Wyn Roberts : There remains in Wales considerable surplus capacity in schools resulting from falling numbers of pupils. Where there is insufficient capacity in existing Welsh-medium schools to meet parental demands for Welsh-medium education, I would encourage local education authorities to take steps to reorganise their provision so as to meet the demand. It is for LEAs to initiate proposals for such schemes. Gross provision for local authority capital expenditure on education was increased by 42 per cent. between 1985-86 and 1988-89. Next year provision will be increased by a further 11 per cent to £52.9 million. One of the main objectives of these increases has been to encourage rationalisation.

This passage gives some indication of the opportunity made available to those empowered at the local level to vire or divert increased levels of capital spending in ways that corresponded with their priorities. Those priorities usually meant not allowing a single school to over expand, or over-develop its provision.

On a UK wide basis, there was a movement by schools towards the formation of consortia and clusters, in order to consolidate their positions in the process of reform, as the role and influence of LEAs changed (Bridges & Husbands,1996, and Hargreaves, 1996). Husbands (1996) identified three different models of collaboration which could be distinguished according to criteria such as: Purchasing, Professionalism and Partnership. This researcher stressed the notion of a "perfect market" where all schools in an area were able to make available the same provision. As part of this movement towards increased

levels of collaboration, Welsh schools formed their own association, CYDAG, to coordinate the development of Welsh medium education. CYDAG allowed teachers and managers on an all-Wales level to meet and coordinate their work in different areas of the curriculum. For example, mathematics teachers would meet on a yearly basis and share practice around current issues.

In contrast to the previous policy of allowing local authorities to determine the nature of capital spending on schools as seen above, the popular schools initiative (PSI), a scheme whereby "oversubscribed" schools could bid, directly or via their LEA, to borrow substantial funds in order to expand, broke with tradition and added further pressure on school consortia.

This increased pressure on school consortia again encouraged extensions to the curriculum as well as meaningful attempts at collaboration. In some cases, additional coordinators were appointed by LEAs to facilitate the dissemination of partnership schemes to cover specific areas of the curriculum that were in obvious need of development. Obviously, the capital spending that PSI allowed, gave some schools the opportunity to develop the status of Welsh medium education, but, at the same time, fulfill another higher tier priority: increase their capacity for other pupils. Naturally, initiating partnerships would allow the policies that defined the ethos of some schools to be disseminated rapidly to the remaining schools across an authority, minimizing the differences perpetuated between schools if implemented effectively.

It seems, however, that consortia policies of this kind may have created new groups of parents who could claim they were being disadvantaged, as the freedom to make choices under delimited conditions included the possibility of making an inappropriate choice based on what they considered to be the most advantageous option. In some cases, factors other than making the best use of cultural capital contributed to parental choice.

In Wales, policies encouraged by the higher tiers of management eventually matched this local theme of partnership and this coincided with the changing political landscape, which I will outline briefly here. After an initial swing to the right in the early 1980s, Wales saw a steep decline in right wing representation at Westminster until it eventually disappeared, only to be resurrected by the proportional representation system

of the devolved Assembly at the end of the period. As central support for neo-liberal aspirations declined, it was superseded by a culture of collaboration and partnership as articulated in *The Learning Country* (WAG, 2002), a policy document informed by visits to Canada and Australia. Canada, especially, seems to share similarities with educational development in Wales: see Churchill (1998) for an outline of schools collaborating in response to cuts, as well as the Ottawa-Carlton school board web site for an endorsement of partnerships.

In practical terms, the climate of partnerships was encouraged further by the General Teaching Council for Wales (GTCW) a new organization established by the Welsh Assembly Government to register all teachers in maintained schools in Wales. The variety of continuous professional development (CPD) schemes offered by the GTCW included one which resourced groups of "teachers from one subject area, school cluster or LEA to work together on a regular basis" (Journal of the GTCW, 2003: 10). Of course, through such encouragement, many teachers would be engaged in a process that, despite the inevitable variations in implementation, would offset the reforms making that process appear comparatively mature.

These partnerships served existing schools well by insulating them from the rigors of reform and associated changes in the levels of funding. The partnerships aimed to preserve the existing intakes, and share resources to deal with the implications of the extensions to the curriculum that have accumulated over many years. It is worth noting, however, that not every arrangement involved expansion; some partnerships engaged in comprehensive consolidation of the curriculum, affecting year 12 and 13 provision, but leaving secondary school intakes unchanged.

There is, of course, another form of partnership, of the type that Fielding (1996) suggested was not in the interests of an established community and that Bridges & Husbands (1996: 6) referred to in equally negative terms as possibly compromising the quality of education. This kind of partnership contributes towards distinctive schools by making them leading players in teaching parts of the curriculum. Most recently, this form of partnership has become a feature of schooling in England. It is the type of partnership,

however, that Fielding advocated that has been a constant feature of developments in Wales.

4.3.3   Classroom practice and the discourse on 'dual literacy'

Other practical steps to encourage pupils to remain with their local school were being taken by LEAs from the mid 1980s and preceded national strategies in Wales by several years. One such strategy, which was used in many areas was outlined in this way in one area after an appraisal had been carried out:

> " The Appraisal pointed to the need to take a closer look at methods of developing bilingualism in pupils who spoke Welsh as a second language in secondary schools, and at a method of streaming and setting in the case of good learners in secondary schools with over 600 pupils in linguistically mixed areas."

> C.Williams, (2003)

As the reforms continued apace, changes such as this were extended to include other schools. Those changes from the organisational norms reflected the existing micro politics in each school (Hoyle, 1986). Some schools serving relatively homogeneous bilingual communities were able to apply wholesale policies across every subject and class. More heterogeneous areas targeted a small number of pupils and subjects.

I will now discuss the broad nature of Welsh medium classes and bilingual classes present in rural secondary schools, although I need to acknowledge that the picture across Wales is multifaceted and quite complex.

Classes vary due to local linguistic conditions. Welsh medium classes are classes where Welsh is the official language of the classroom and usually the principal means of communication. A visitor to such classes might expect to see precedence given to Welsh terms. In rural areas, Welsh medium classes are usually found in anglicised parts and are, in the main, mixed ability in nature. Bilingual classes include some pupils learning through the medium of English, many of whom are Welsh first language speakers, and some pupils learning through the medium of Welsh. These bilingual classes are found in the traditional rural areas where there remain a significant percentage of Welsh first

language speakers. The provision in this latter type of class is sometimes referred to by the term "parallel teaching."

Less common is the practice of mixed first language classes alternating the medium of instruction to tackle different units of work. With this approach, some pupils who might otherwise build knowledge through their second language whilst possessing weak second language skills, would be obliged to do so partly in their first and strongest language and vice versa.

By adopting bilingual teaching methods especially with "good learners", it became possible to fill surplus places in some schools. One strategy involved setting up an additional bilingual stream for pupils categorised as good learners in subjects such as music, history or geography where the teacher was bilingual. These pupils would rejoin their English medium peers in mathematics and science. The classes created for these good learners could be small and have a particular ethos. Of course, the definition of a good learner is open to different interpretation from one Welsh area to the next, usually leading to modifications in teaching.

By way of example, traditional rural schools running three streams in mathematics under this system would have four registration groups, these four classes would continue into subjects such as geography, history, art, and music with the bilingual class being, perhaps, only partially full. As surplus places increase, schools might choose to extend these classes into less conventional areas such as mathematics and science. There might even be an incentive to do so within the formula funding underpinning the language policy of a school. The nature of such arrangements would depend on locality and also position within the educational partnership.

4.3.4   Extending the Curriculum: a national approach

It is well appreciated that the Welsh education agenda has included a drive to broaden the experience of Key Stage five students. Two initiatives have been introduced that extend the Key Stage five curriculum, but they have been applied in different ways to the schools. The first, Key Skills, was applied to all schools. The second, the Welsh

baccalaureate (Jenkins et al, 1997), has been trialled across a small number of large schools. Of course, both methods have timetabling implications for the schools involved, particularly for the core subjects. With regard to Key Skills, small schools, whose classrooms and teachers were already fully occupied, had to consider changing the number and length of lessons in a week to accommodate the extension i.e. requiring a re-examination of teaching and learning by teachers. The second approach, adopting the baccalaureate, was probably more sensitive to the needs of small rural secondary schools which found it less easy to adapt through continuous extension.

4.4 Summary

In summarising the developments arising from the education reforms, we see that the number of reforms in Wales mounted up quickly and exceeded those implemented in England. Then again, the process of education reform in Wales has had an extra element of differentiation, which was and is still proving attractive to many parents. Calls made for Welsh policy to revert to previous classroom methodology based on shared intakes and mixed ability teaching (e.g. Fitz 2000: 42-43), a methodology that some have suggested actually diminishes the prospects of working class children, should not be considered in isolation, but rather as one proposal in a series of related measures that have contributed to the lessening of the impact of Welsh Language Planning proposals. Such calls may also reflect the fact that Welsh medium classrooms are becoming more diverse, in line with curriculum extensions and financial stringency.

CHAPTER 5

SECONDARY SCHOOLS IN RURAL WALES: LANGUAGE PLANNING IN THE CONTEXT OF EDUCATIONAL REFORM

5.1 Introduction

In this chapter, I explore the changing landscape pertaining to secondary schools with the following questions as my guidelines:

1) How did Welsh rural secondary schools develop into their present form?

2) What were the responses of different LEAs to the education reforms of the 1990s combined with the new expectations placed upon them by the Welsh Language Board?

3) How did these responses impinge upon the conditions within Welsh medium mathematics classrooms?

5.2   A synopsis of Welsh rural secondary school development

As I indicated in Chapter 3, to address the changing demands of communities, the secondary schools of rural Wales have adapted themselves over the last half-century by gradually increasing the domains of Welsh. The secondary schools evolved in stages. Beginning with schools that once delivered a purely English medium curriculum, they changed to offer the foundation subjects through Welsh, earning the name "traditional" Welsh schools in the process.

The next stage of the development began in the 1980s. Traditional schools evolved into bilingual schools where parents, looking for new levels of opportunity for Welsh-medium provision, were accommodated by the creation of Welsh medium streams that encroached, to differing degrees, on different subjects in the curriculum, or by teaching using both languages in the same class. There was greater capacity to accommodate changing tastes since bilingual members of staff were *in situ* and in sufficient numbers to make an immediate impact on provision; where existing staff encountered difficulty in making the change, parallel appointments were made. These were usually appointments of junior staff, many of whom were recruited, with the aid of substantial bursaries, in the late 1980s in response to the high demand for their language skills from traditional Welsh schools. Two things can be said about these teachers. First, they were originally

appointed in a comparatively supportive climate, but gradually saw this climate change as the reforms of the late 1980s began to have an effect. Secondly, the teachers may have been initiated, subtly, into communicative practices and classroom routines that circumscribed the actual use of Welsh, thereby reducing their impact on the schools.

The next section analyses the Welsh Education Schemes and documents that were constructed to meet the statutory requirements of the Welsh Language Board (C. H. Williams, 2000:88). Public bodies had to demonstrate how they intended to meet the needs of Welsh speakers across many domains including education. These schemes coincided with the developments above. I have dedicated a sub section in the references to the documents that were examined as a foundation for the following section.

5.3 Formalising Local Education Authority approaches to reform.

This section focuses much more closely on the policies of LEAs and the schools they coordinated as they developed strategies to address the challenges of the education reforms.

I will look at two local authorities: Area 1 LEA, and Area 2 LEA. Radnor and Ball (1996) undertook a similar study of the responses of LEAs to the Education Acts of 1988, 1992 and 1993. They described the establishment of " new partnerships for old" as an approach to dealing with Local Management of Schools (LMS). They highlighted a range of local responses by LEAs, ranging from those acting as an agent of central Government to those that were creating obstacles.

The authorities that I chose to study adopted or enhanced the role of partner and this was most evident in their language from 1997 onwards, when, coincidentally, there was a change of governance in the UK e.g. Following inspections, schools were asked to participate in partnered reviews with LEA advisory services. The authorities differed in that Area 1 had a strong Welsh language presence in its population whilst Area 2 had only small pockets of Welsh speakers and these were very much in a minority in the whole population. The responses of the authorities to the reforms were similar in that each one attempted to retain intakes across its schools by extending provision. Each adopted a slightly different approach, however, to achieving this end.

The attempt to accommodate forms of Welsh medium provision through a gradual process of extending the curriculum had less obvious implications. For example, some schools' development on the English medium side were affected by the levels of effort invested in translation of Welsh resources. It was also quite well appreciated within the profession that provision of more streaming for English medium classes would attract pupils from Welsh medium classes. Extending the curriculum increased the availability of alternative provision significantly, but in percentage terms the movement of pupils was very low (Area 1 LEA Welsh education scheme, 2001). This movement was sometimes on an internal basis (catchment area pupils) from English stream to Welsh stream in the same secondary school, and on an external basis from English medium schools to Welsh streams in bilingual schools. The latter type of movement was encouraged by teachers visiting out of catchment area primary schools in some areas. The curricular expansion was also encouraged by the favourable financial support that traditional schools received through formula funding., (This was based partly on the numbers in different Welsh streams). This was by no means the only form of pupil movement, however. Some parents tried to avoid the consequences of the new commitment to accommodating Welsh medium streams in the traditional schools. It is clear that these decisions were not well received by management at the intermediate tier.

5.3.1   Coordination of Language Planning in Area 1

A close inspection of the school models proposed by Area 1 in its education Scheme, which was conducted for this study, showed a convergence of curricula. This contrasted with the discourse emanating from central government in the early and mid 1990s that promised diversity between schools, but again was in line with Handy's organisational theory. Area 1 adopted a three-tier model of education in its secondary schools. Interestingly, this approach resonated with the proposals made in Ottawa under its School Board's *New Vision* (2000) document. Area 1's scheme included semi-specialist schools, one of which was on the verge of evolving further from being a traditional bilingual school into a designated school with the remaining schools being traditional bilingual schools or English medium comprehensives. To avoid the separate provision implied by the latter phrase, an unfamiliar noun phrase was applied that

ensured the word 'bilingual' was attached to all schools. This approach also mirrored the language policies in other traditional areas.

Area 1 LEA's strategy for 2001-2004 was to focus on the language policies of the schools and to continue to accommodate pluralistic tendencies and to allow for differing shades of bilingual competence. This entailed enveloping all pupils in an attempted coordinated change in the habits, attitudes and beliefs in the schools. Schools were expected to ensure that the Welsh language was used in their administration, social life, pastoral arrangements and curricular provision. They were also expected to ensure that the ethos of classrooms promoted bilingualism; probably the most difficult task to accomplish as individuals' personal commitment can influence the nature of bilingual practice in the classroom. The uniform development of local policy was emphasised by each school being required to outline the merits of bilingualism in its prospectus. This was partly in response to the impact of LMS, which had allowed some primary schools to withdraw from 'buying in' some Welsh language provision and to concentrate on other priorities. Inevitably, this led to demand for Welsh services at LEA level to decline. It is difficult to assess, however, whether schools behaving independently would have created opportunities to organize children along more egalitarian lines, for example where fewer children would experience domination in second language learning of either Welsh or English.

Turning more specifically to the organisation of pupils in Area 1, appendix 1 shows a table produced by the LEA to describe the distribution of year 9 pupils across and within its schools. In the year 2000, the traditional/bilingual schools of the LEA had roughly one third of pupils at each level of bilingual provision, receiving 60%, 40% or 20% of the curriculum via the medium of Welsh. A less positive outlook for the status of Welsh is gained by considering the percentage of the curriculum taught through English (40%, 60% and 80% for the different categories). The percentage of pupils at each level of bilingual provision obviously indicated the overall level of Welsh medium education in each catchment area, but they also indicated that similar intakes were being retained, on the whole, by the schools. The percentage of Welsh medium education available in each linguistic level at the time was also a measure of the established conventions within and between those institutions; the percentages also showed the constraints on the role of

Welsh in core areas of the curriculum (mathematics and science) and therefore revealed its positioning as not being of high value and high status. On paper, there appears to be a standardization of classes in line with the model of bilingual practice described and encouraged by Dodson (1995). At this point I am not trying to suggest that the composition of these classes and their curriculum was a compromise which was bound up with the collective survival of the institutions, but as the schools were relying by and large on the same intakes, their composition was more complex than suggested by simple classifications such as those underpinning such models of bilingual education.

As part of the strategy in Area 1, designated schools were set a target to increase the "opportunity" for learning all subjects through the medium of Welsh at Key Stage three (KS3) by 2004. However, just running one mixed ability stream satisfied this condition in subjects such as mathematics, as did making provision "available" within mixed language classes. The individual targets for Welsh medium development at KS3 in the traditional schools by 2004 implied a significant break with established conventions i.e. mathematics and science being introduced in Welsh. The proximity of traditional schools to designated schools and the slight trend for pupils to gravitate towards designated schools and other alternatives meant that one traditional school aimed to increase the available Welsh medium provision to 82% whilst other traditional schools had no less ambitious KS3 targets for the teachers involved, those ranged from 72% to 75%. Perhaps significantly, however, competent learners were also targeted in most schools to experience a rise from 40% to either 45% or mostly 50% of curriculum time via Welsh medium instruction. Linked to these changes was a transport policy that favoured catchment areas. One effect of such a policy was to guide parents in the direction favoured by existing providers. The other obvious effect was to make open enrolment a policy that empowered affluent parents who had the means to pay for school transport beyond their catchment area.

Area 1 LEA also set an additional complementary target for the traditional schools, it aimed to increase the percentage of pupils in the 60% band and reduce the percentage in other bands. This policy would extend second language teaching through Welsh for some pupils and impact on the classroom environment in unpredictable ways. Non-core subject teachers would experience a more challenging instructional context. No

doubt, some schools and some coordinators anticipated this and arranged for additional classroom support. Moving on to Key Stage 4, Appendix 2 shows the situation at this stage with the subsidiary role for Welsh continuing, but also the curriculum overlap between institutions becoming more apparent.

Underpinning these curriculum and classroom changes were the Welsh medium 'allowances' (or grants) distributed broadly by Area 1 LEA and shown in Appendix 3. Area 1 LEA's funding formula was less demanding than that of Area 2 LEA (also shown as a draft in Appendix 3) in that it did not encourage schools to make changes. This reflected the comparatively high percentage of Welsh speakers in the area. The authority gave secondary schools money for each subject after the third Welsh medium subject "offered". The funding formula can be interpreted as a means of subsidising schools, which could not contemplate implementing the changes necessary within their existing budgetary allowances, in order to prevent the movement of pupils.

The organisation and the subsequent teaching and learning of subjects in a designated bilingual school that was once perhaps more distinctively Welsh in its ethos, complemented the managerial developments that came in response to the reforms. The school's bilingual policy took the following broad nature:

a) The teaching of mathematics and science through the medium of English or Welsh, according to parental choice.

b) The teaching of all other subjects through the medium of Welsh.

c) Pupils sit public examinations in the language in which they were taught.

d) Following (a) and (b) above, teachers will use both languages orally when necessary and will teach technical terms in both languages as and when necessary. Textbooks in either language are used as appropriate.

(Designated school Web Site, 2002)

Overall, schools with such policies regarding bilingual practice at the classroom level remain closely allied to their consortium partners.

School policy statements such as that above leave a good deal unsaid. The minutiae of classroom communication are often overlooked, along with the ways in which language mediates learning and the building of classroom relationships. Cumulatively,

this can have a bearing on the nature of the bilingualism being promoted within a classroom and it can affect the levels of participation by different categories of pupils. There may nevertheless therefore be opportunities within every category of school to alter the ways that teachers and learners communicate about different areas of the curriculum so as to increase participation. More research of this nature is needed. This study endeavours to narrow the research lens to the level of classroom communication.

5.3.2   *Coordination of Language Planning in Area 2*

The second authority, Area 2 LEA, also aimed to have policies that guided pupils into local schools. However, its response to requests for specific Welsh medium education provision was different in curriculum terms than the arrangements developing in Area 1 LEA. Its response was shaped by a number of local and UK national developments, including the coordinated activities in support of a designated Welsh medium school in the area by a coalition of local parents and the impact of financial intervention by the State under PSI. The Authority coordinated responses to lessen the impact of such destabilising interventions. One component of its formula funding encouraged schools to provide more than five subjects through the medium of Welsh whilst another component was directed at separate Welsh medium groups. This coincided with a broad approach in which Welsh medium streams were funded so that they ran with small numbers of pupils during the 1980s in a few schools. As these streams filled up and PSI was managed by the LEA and by those at a more local level to limit its impact, the policy was extended to the remaining schools and these new streams were also funded so that they ran, initially, with low numbers of pupils. A statement in a draft LEA plan shows the kind of thinking behind the broad approach of establishing Welsh medium units and streams within common schools. The reasoning was worded as follows:

"A development of the Welsh language in all secondary schools rather than the creation of a number of designated bilingual schools... as an approach is considered a better opportunity for positive community involvement than schools that only cater for a section of the population."

(LEA, Web Site, 2002)

Some consequences of this broad, LEA-wide approach were foreseen, and someone with experience of primary school teaching would recognise the characteristics of over-ambitious attempts to provide Welsh medium classes in every year of the secondary schools. These included mixed ability teaching and, of course, the various definitions of that concept held by different teachers. Their thinking has been influenced by two slightly different developments. First, the changes in the assessment requirements at GCSE e.g., (1.) the need to differentiate according to examination requirements (recognised as streaming within a mixed ability class by some); (2.) the need to limit that differentiation by adopting whole class teaching methods for investigations and projects. Secondly, the narrower assessment criteria observable in the year 9 SAT examinations. What is striking is that arrangements for mixed ability teaching in Welsh medium classes were not applied in English medium classes.

In a review conducted into Area 2 LEA's first Welsh Education Scheme between September 2000 and March 2001 more obvious consequences resulting from their broad policy implementation approach emerged. These were highlighted in an Estyn inspection in September 2001 reporting on provision and standards in Welsh and Welsh medium education (Estyn, 2002). The extension of Welsh medium education across the Authority meant that three levels of provision emerged. A majority of the schools offered at least three subjects through the medium of Welsh in Key Stage Three, but of those schools, less than half had been targeted to make all subjects available through the medium of Welsh by 2003.

Some differences between policy and practice were apparent; these were:

1   Partial provision or non-availability in some areas.
2   Delimited opportunities to continue to study through the medium of Welsh at Key Stage Four.
3   Availability of post 16 provision.
4   Difficulties with recruitment of Welsh medium teachers.

On two occasions the inspection report drew attention to the need to address the final point with a strategy to overcome staffing shortages. Nevertheless, despite these differences, the Estyn report acknowledged, "the significant development that has taken place in access to Welsh medium education", but made no analysis of the nature of what

parents and children were accessing. The inspection report, on another two occasions, referred to decisions to 'rationalise' Welsh medium education. Over the long term, the extent of rationalisation was never fully clear and the situation was perhaps less reassuring than that conveyed by the report.

The inspection report also included brief references to the "high costs" of some aspects of the Welsh medium provision (total cost amounting to £1.8 million). These aspects were most obviously connected to staffing, including the employment of bilinguals for Welsh medium teaching and support for the ensuing low pupil teacher ratios. In some areas, this had an impact on the manageability of classes, and there was a duplication of resources. Conveying some concern in relation to the inevitable escalation of costs from the continued expansion of Welsh medium education, paragraph 7.12 in the inspection report stated the Authority had, "identified the need to explore more fully the potential financial savings to be gained from organising alternative provision." (Estyn, 2002).

5.4   *Diverging conditions in Welsh medium mathematics classrooms.*

I have discussed above some of the local managerial decisions made to address the changing expectations of Welsh-speaking parents stimulated by central policies and resources. How these decisions impacted on the teaching and learning of mathematics is where I now want to focus my attention.

This discussion, in some respects, addresses the call made by Williams to consider the effectiveness of Welsh medium units. Williams says, with regard to the practice of establishing Welsh medium units:

"Such units continue to be a permanent fixture in parts of Wales, and their success under different conditions needs to be considered."

I.W. Williams, (2003:15)

However, thus far, there has been no systematic research which has aimed to examine in detail the "different conditions" experienced by teachers over the last twenty years or so. This study represents a first attempt to undertake research of this kind. Before I turn to the detail of the empirical work that I have undertaken, I will set the scene for

the final chapters of this thesis by outlining the growing discrepancy between the discourse of mathematics policy documents in Wales and actual pedagogic practice.

In 1981, a report by Her Majesty's Inspectorate (HMI) on Welsh medium education noted the prevailing use of traditional teaching methodology in Welsh medium classes, but anticipated that there would need to be greater use of methodology designed to cope with mixed ability classes. In the 1980s, as Welsh-medium education was being extended and consolidated to meet parental demands, mixed ability teaching came to be seen as a necessary feature of Welsh-medium classes. In mathematics, for example, there was extensive use of teaching approaches and schemes specifically designed for mixed ability teaching. This followed from comments in the Cockcroft report (1982), which referred to teaching material that was being produced in Welsh, which had to serve the needs of all pupils. According to the Cockcroft report it was both urgent and essential that more suitable material be made available in Welsh. The authors acknowledged that some teachers were able to, "work in stimulating and effective ways with pupils in mixed ability groups." (Cockcroft, 1982: 151) However, other voices within the report were opposed to mixed ability teaching and argued that standards were likely to suffer. Early reports, such as this one, revealed a tension between a commitment to mixed ability provision and the development of quality provision for Welsh medium education. This tension has been present in many schools in Wales and has been increasing steadily ever since. Let me focus on Area 2 LEA for the time being in order to delineate how this tension was manifested.

In the late 1980s and early 1990s mathematics in Area 2 LEA was organised in keeping with a Post 14-policy document (early 1990s), which talked of consortia and partnership. Within this framework, the authority supported individualised graduated assessment schemes such as the SMP Green Scheme and schools duly complied and used the scheme.

The document suggested there were certain common areas of concern that could be addressed by the different schools in the consortium. These included:

1   The development of banks of resources for all elements of the GCSE courses.

2   The need to cater effectively for wide ranges of ability in the classroom,
         `particularly in the case of mixed GCSE level classes.

This last point reflected the awareness, among those devising local policies, of the nature of the challenges facing Welsh medium teachers, as a result of the inclusive strategies being adopted.

For mathematics, the disadvantages of distributing resources across schools could be clearly seen in the ways in which examinations are organised, but it is worth reviewing them. Firstly, mathematics has three tiers for examination purposes at Key Stage three. These tiers include levels three to five, levels four to six and finally levels five to seven, although at the beginning of the reforms there were papers that covered levels six to eight. At GCSE the picture is repeated with pupils entered for foundation, intermediate and higher papers. Even the most developed Welsh medium provider would, most probably, have to combine pupils into different ability tiers to create classes in some way. Naturally, the focus should not only be on Welsh medium pupils; some English medium pupils in small schools would face similar issues.

The learning strategies outlined at the beginning of the 1990s in LEA 2 were based on the kind of thinking illustrated below.

" It <u>should</u> be appreciated that children learn at different rates, in ways personal to the individual. An individual's rate of learning <u>will</u> not be constant but <u>will</u> vary according to circumstances and the type of work in progress. It therefore follows that the teacher <u>should</u> offer a range of experiences and presentation. The teacher <u>should</u> select activities taking full account of the current level of understanding of each learner. It <u>should</u> be appreciated that children possess an ability to think mathematically that can be encouraged or discouraged by the type of activity presented." 								(Ibid.)

The language is comparatively liberal in that the status of the learner appears to be paramount. The modality of the text by comparison is authoritative with the repetitive use of the modal verbs "should" and "will".

Teaching in an environment where this was a guiding discourse may have been a somewhat harmonious affair for Welsh medium mathematics teachers and English medium mathematics teachers in the smaller schools and in the early years of secondary schooling across Area 2 LEA. The policy document cited above was sympathetic to the inclusion of individualised teaching schemes within a broad and flexible overall delivery

to cope with the practice of organizing Years 7 and 8, in particular, along mixed ability lines. The LEA had therefore adopted structures and methodology for their management, which were to become the focus of change for other bodies.

As many are aware, by the mid to late 1990s, there was a distinct change in climate in schools: all teachers were being encouraged to engage in more didactic intervention with teaching groups focused on fewer levels of work whilst on the same topic. This change was in line with increased expectations for more streaming, mental arithmetic and whole class teaching. Moreover, teachers were encouraged at this time (2000-2001) to adopt national strategies, which had their origins in England, though they were not compulsory in Wales. These prescriptive measures, however, were influential and guided the choice of teaching materials. One example was a set of mathematics material entitled: *Bridging units in mathematics*, which included 16 lessons on fractions, decimals and percentages. It recommended three part lessons beginning with a mental starter followed by a main session of individual or group work and finally a plenary session. It advised that:

> "The teacher should play a central role throughout the lesson by instructing, explaining and demonstrating"

(QCA, 2000:4)

This different way of working was the antithesis of the methods associated with individualised schemes initially adopted in the 1980s and designed with mixed ability classes in mind.

This change of climate was also reflected in the type of teaching material that mathematics teachers wanted translated and published in Welsh. Those materials included the Vickers mathematics scheme, Key Maths in Key Stage 3 and, to a lesser extent, Heinemann mathematics in Years 7 and 8. This movement in mathematical discourse and practice, with more "liberal" approaches to the mathematics curriculum being downplayed and their drawbacks accentuated, may have meant that it was mostly English medium teachers who were better able to participate in the broad realignment of schooling that preferred to adopt streaming and extend its use earlier in secondary schools.

5.5   *Summary*

Let me now summarise the reasoning behind the Welsh Education Schemes of both the authorities in this chapter. The schemes can be interpreted as attempts to offset the effects of open enrolment and LMS, two policies that had the potential to destabilise the practices of existing local consortia in Wales. These schemes had a far-reaching effect on the nature and scope of Welsh medium teaching and learning in the field of mathematics.

Given the diverse intake of pupils, the possibility of polarization in terms of both subject and linguistic ability in classes across every age group in secondary schools may have led schools, local authorities and Estyn to look at arrangements that might mitigate policy effects. Thus, there has been an emphasis on testing and streaming, along with new practices relating to the organization of pupils. Two options emerged within existing structures:

1)   That of obtaining financial assistance for further division of classes along language lines

2)   That of reducing opportunities for pupils to engage in knowledge building through their first or preferred language.

The first has led to smaller classes and, as a consequence, some aspects of mathematics teaching have been affected e.g. the ability of teachers to do group work. Some rural schools have applied the second option and have adopted the term 'parallel teaching' and the general term 'dual literacy' discussed earlier. However, if we look at the intricacies of classroom interactions, we will see that putting these ideas into practice is not without complications.

Having discussed the educational context of the study from the points of view of language planning and policy, educational reform and school and local authority policy in the wake of educational reform, I now move on to discuss the research methodology for the study.

PART III THE STUDY

CHAPTER 6
RESEARCH METHODOLOGY

6.1   The approach adopted in this study

The multi-level analysis in this study was informed by the work of researchers in different disciplinary traditions including Hornberger and Johnson (2007), Gerwitz, Ball and Bowe (1995) and also Hoyle (1986). I gathered data, initially by focusing on elements of school life that resonated with my concerns. I was building on the experience I gathered during events at two rural secondary schools where I worked as a mathematics teacher over a ten-year period. This experience had also begun to broaden to include events at other similar secondary schools, as well as meetings between teachers at LEA level and an all Wales level.

The integrated multi-level nature of the research meant that my classroom and school-wide observations of organisation and management practices were coupled with an analysis of texts such as:

- LEA education schemes, related to mainly Welsh medium development and accepted by the Welsh Language Board.
- An inspection report relating to a Welsh Education Scheme.
- An LEA mathematics policy document
- A higher tier mathematics scheme for teaching a series of lessons on fractions, decimals and percentages.

Taking account of these and other texts meant I was better prepared to interpret data obtained from interviews undertaken in the schools with mathematics teachers. My method ensured that I remained aware of the wider policy context in which these accounts were framed, but it also ensured that my interpretations were grounded in real life events. As Wodak and Meyer (2001) state: " All discourses are historical and can therefore only be understood with reference to their context." (P15).

This study also drew on textual material produced by other visitors to the classrooms. This was another important source of data. These visitors were often people such as inspectors working within the system so they were monitoring teachers' practices and seeing these practices through particular eyes so they were not 'neutral' observers.

Drawing on my own experience as a practitioner, in association with data from other sources helped me to fit together the pieces of the jigsaw, and allowed a more complete analysis and understanding of language education policy I was concerned with and its impact.

In this study I adopted a primarily qualitative interpretive approach. Romaine (1984, cited in Edwards & Westgate 1994:60), equates the appropriateness of research methodology to the nature of the research questions asked. Edwards and Westgate (1994) also argue for an eclectic approach, as can be seen in this next passage:

> "It does not mean attempting to include the incompatible within the same study, but bringing together concepts and methods which can yield complementary insights into the same phenomena, or can bring into view different aspects of classroom talk and its organization."

<div align="right">Edwards & Westgate, (1994:60)</div>

Others in Wood and Kroger (2000) go into greater detail, listing four main types of data needed in detailed interpretive research: members' generalizations, 'neutral' objective observations, individual members' experience and observers' interactions with members. All of these kinds of data were gathered during the first stage of the research.

There were a number of challenges that arose for me as a practitioner-researcher during the research process. One of the main challenges lay in the fact that I had been working in a field, Welsh-medium and bilingual education, which had projected on to it a strong ideology. In fulfilling my roles at different stages as a Welsh medium, English medium and bilingual teacher, I was expected to adopt arguments in favour of each form of provision. Doing the research, however, allowed me to disentangle myself from the ideologies that had governed my work as a practitioner, and allowed me to adopt a more considered perspective.

The next stage of the research involved choosing my approach to data analysis. Once I had gathered sufficient in-depth knowledge about rural schools and the local political and administrative procedures that regulated them, I was in a better position to undertake a discourse analysis of documents and literature associated with bilingual education in Wales. There had been an increased level of text production about Welsh Language Planning and policy developments since the turn of the millennium, including

the reminiscences of retired rural education officers about Welsh medium development from the beginning of the reforms to the mid 1990s; a media debate on education in which different discourses circulated; and texts linked to the politics of language standardization. This meant that a discourse analysis approach of some of those texts and discussions was likely to yield interesting results. I relied on the methods demonstrated and recommended by Wood & Kroger (2000) and Wodak & Meyer (2001) drawing extensively from the field of critical discourse analysis, especially Fairclough (1995), (2001) and Van Dijk (2001).

This concentration on discourse fitted neatly with another research paradigm that had come to my attention earlier in my studies. Through extensive reading during the first stage of the study, I had become aware of Post-structuralism, (e.g. Ball, 1994). Post-structuralist analyses involve careful consideration of the discourses that institutions and the stakeholders within them adopt; these discourses are the mechanisms by which power and authority are maintained within institutions. They are often to be found in official documents created by schools and LEAs, but also in discussions at meetings between teachers. Those who are quite familiar with the nuances of day to day life in organisations will be conscious that such institutional discourses can overwhelm alternative perspectives and often subsume versions of them. In practical terms, this exercise of discursive power can result in particular social actors being edged further from the mainstream, as occurred in some parts of Wales. Sometimes it involved simply deleting less conducive wording from national policies that no longer fitted local priorities.

There have, of course, been criticisms of the discourse analysis approach. Attention has been drawn to the unevenness of interpretations due to the differing backgrounds and experience of analysts and their relative positions of power. Even when criticism of the discourse analysis approach is factored in (see Wodak and Meyer (2001)), discourse analysis is still a powerful tool. Discourse analysis allows members of the research community and others who are familiar with the method to examine the meaning of words within text and the role of words and their manipulation in serving the interests of the different groups in society. To new members of the research community, discourse analysis represents a practical route to unmasking the techniques of management. Its appeal lies in its ability to lay bare the ideological stances of text producers.

6.2   The schools and the teachers

A series of interviews was conducted with mathematics teachers (including minority and majority language teachers) in a small number of rural secondary schools from LEAs where the sociolinguistic conditions contrasted. This was Phase 1 of the data collection in this study. The schools were selected on the basis of the criterion that they were at different stages of Welsh medium development.

School A had acquired the status of designated bilingual school in the mid 1980s and was in the process of extending the availability of Welsh medium provision up to a target of 100% availability set by the LEA. The school was situated in LEA Area 1.

School B was a large traditional rural secondary school, which was losing pupils. The decline in numbers was quite significant with the roll down from a figure in the mid 900s to one in the mid 700s. The school was also situated in LEA Area 1

School C was also a large rural secondary school. It had grown significantly over a period of ten years by around 50%. The school was known to have started Welsh medium provision in the early 1980s in response to a concerted campaign from parents who eventually belonged to RHAG (a parental lobby group – see glossary). Provision at the school was well advanced, so much so that subjects such as science and mathematics were being taught through the medium of Welsh from as early as the late 1980s. The school was situated in LEA Area 2.

Table 1, below, sums up the situation across both LEAs and within each of the schools taking part in the study.

Table 1. Research sites and participants

Schools	LEAs	Teachers	Class	Pupils	Type of school (Category)	Type of provision for mathematics
A	First LEA	A1	Year 8	Mostly L1 Welsh	LEA Designated to extend Welsh medium courses for all pupils	Bilingual approach
		A2	Year 10	More L2 speakers		
B		B1		*No classroom observations*	Traditional Welsh Bilingual	Mathematics taught through the medium of English with short units of work dedicated to Welsh medium teaching being introduced gradually in year 7. Setting by ability from year 8 onwards through the medium of English.
		B2				
C	Second LEA	C1	Year 8	L1 English & some L1 Welsh speakers	LEA Designated to provide Welsh medium courses in separate streams where possible	English medium stream
		C2	Year 10	L1 Welsh & some L2 speakers		Welsh medium stream
		C3	Year 10	L1 English some L1 Welsh speakers		English medium stream
		C4	Year 8	L1 Welsh speakers & L2 speakers		Welsh medium stream

Data was gathered over a period of two school terms, the summer and autumn terms of 2004. Following a letter of introduction, head teachers were contacted by phone and given a brief outline of the aims and the methods involved in the research. The head teachers responded positively to my request. Subsequently heads of department began to contact me and dates and times for the interviews were arranged quite quickly.

Twelve questions were prepared for these interviews. These corresponded to the concerns I outlined in the introduction, and these can be seen in appendix 4 along with the brief introduction to the research that I gave to the participants and head teachers which is included in appendix 5. I generally took a semi-structured approach to the

interviews. They evolved in response to the teacher's answers. The interviews were conducted in the mathematics rooms where the teachers worked. The times for each interview are noted on the transcriptions. The teachers' responses were recorded, transcribed and translated, if necessary, and a copy returned to them with an invitation to make observations to me by e-mail. Their responses were included in the analysis. Where English was used in the original transcript, I have used italics to differentiate between languages. As is customary, names and places were deleted from the transcripts and it was agreed with the teachers that sensitive material would be edited out. The teachers, however, did not raise any issues regarding the interview data.

The problems associated with data collected from interviews are quite well known (see Daugherty and Elfed-Owens, 2003) and these are no different whether the interviewees are from the elite or working in less powerful positions. The obvious difficulty is with interviewees managing their accounts in a favourable way according to their needs and interests. Cortazzi (1993) describes this phenomenon as part of the process of preserving "face". Freebody (2003) also raises the issue of the authenticity of interview accounts, and makes readers aware that authenticity is related to the parameters of the interview situation. The questions posed may also frame the outcome of the interview and slant the findings according to the concerns of the interviewer. On the other hand, the type of question posed can also lead to a seemingly more natural response, and here I refer to the final question in the interview: "Any additional points you would like to raise?" which, by its broad and open nature, tended to draw out the concerns of the interviewees. Provided the known weaknesses are taken into consideration, interviewing can play an important part in building an account of language policy and practice in a particular educational setting, when combined with other research methods.

6.3   Recording and analysing classroom interactions

After the teacher interviews I moved onto Phase 2 of the data collection. Phase 2 was conducted in the autumn of 2004. Following Barwell (2005) the reasoning behind this phase was that discursive practice, specifically interaction, is social in nature and that underpinning the organization and content of interaction are assymetric relations of power. Drawing on Barwell's methodological approach to the analysis of interactions, I

was concerned with the socio-linguistic diversity present in every classroom. I also paid heed to the way that participants deal with their attention since the focus of participants' attention in an interaction is generally on what has been said in preceding utterances. As Barwell observes, speaking of the participants in his study:

" The explicitness of their attention... provides a basis for analysis, since analysts can observe attention just as much as the participant."

Barwell, (2005)

Of course, it may be that participants are drawing from several sources of concern, which are not explicit in preceding utterances, and this might account for some awkward interactions typified by conversational repair between speaker and respondent.

I draw further support for my analysis of text from the study of classroom interaction undertaken by Roberts & Sarangi (2001) who in turn relied on Bourdieu's game metaphor to analyse how students' success and failure is constructed in the classroom. In addition to "attention", I will focus on the quality of talk between teachers and pupils, which indexes social relationships and reveals the positioning of pupils. To facilitate such an analysis, Roberts and Sarangi categorize classroom talk into different types. The first is content talk which can be subdivided into talk involving explanations, examples and justifications and the second is procedural talk where a task is organized, checked and commented upon. According to Roberts & Sarangi, students perceived as problematic experience procedural talk more often than content talk. With reference to procedural talk, Roberts & Sarangi also refer to a type of questioning which is indicative of communicative difficulties called hyper-questioning. In addition they identify metatalk or talk about talk, often involving clarification, which reinforces prevailing social conditions by being productive for successful pupils or a marker of difficulty for less successful pupils. One obvious and prevalent form of talk about talk, which is pertinent to this study, is the use of praise. These, therefore, are the tools that allow me to analyse the discourses present in the classroom that act cumulatively to construct the interactional order, or as Freebody (2003:91) explains, the means by which novices are acculturated into the domains of educational activity.

I contacted the schools in October 2004, to gain informed consent to study interactions in the classroom. The explanation of the research provided to the teachers can be seen in the appendix 6. This part of the research was based on the audio-recording of lessons at Key Stage three and Key Stage four in two of the schools using different language approaches in their mathematics lessons. It was felt that in designing this element, English medium lessons would need to be included for comparison. In practice, however, and after some reflection, I amended the amount of lessons to be audio-recorded. I eventually recorded every lesson as this would ensure the pupils and teachers were working under similar conditions every time I visited. Of course, this approach also increased the amount of data I collected quite significantly.

I decided to concentrate on classes in year 8 and year 10 in both schools as this would give a better cross-section of the teaching practices in the schools. Before arriving at both schools I asked the teachers involved to provide me with some detail of the linguistic background and mathematical ability of the pupils in the classes I would observe. The details I received from all teachers, however, were rather vague and had to be asked for again at the time of the follow up interviews. At school C, I employed a Sanyo micro-cassette with microphone attached to the teacher, but simultaneously recorded the interactions as a whole with a professional cassette recorder placed near to my position in each classroom. On occasions, this dual approach paid dividends by allowing me to double check spoken words especially when teachers were involved in individual tutoring. The quality of the recordings, however, was impaired by cross talk in the classrooms and the inferior nature of the personal micro-cassette.

I did not press teachers to wear the personal microphone at school A having checked the quality of the recording from the professional recorder from school C. On one occasion, however, when I did ask teacher A2 to wear the personal microphone the recording failed. Following transcription, the transcripts were sent to the teachers for editing of any sensitive material with an invitation for them to analyse the interactions. This aspect was important, as the teachers might be the only ones capable of identifying a significant change of behaviour or language use in the classroom. I also engaged in a series of follow up interviews, which were recorded, but not transcribed (See

Appendices10 and 11 for details of preparations for these interviews). Instead, I give a summary of the teachers' comments in Appendix 12.

At this point, I should mention that the process of transcription was not without difficulties. These difficulties centred on the different Welsh accents and regional dialects of those involved. Occasionally, I inadvertently transcribed a teacher's Welsh accent into my own accent and dialect, and I only observed this after completing the final round of interviews in the schools and had begun writing up. I found it hard to follow one strong local accent at times, and on one occasion, in a section that is quoted in the main text, I had to consult a professional translator who had some knowledge, i.e possessed some corresponding cultural capital, in order to make an accurate record of the classroom talk.

6.4   Ethical considerations that influenced the development of the research.

I strived to remain within the ethical guidelines of the British Educational Research Association, accessed (2001), at all times. My classroom data was obtained with informed consent (See Appendices 5 and 6) and the data recorded and transcribed from the lessons was shared with the teachers involved, so that they could use it for their own or departmental development as they saw fit. Material that was in the public domain was drawn upon for the purposes of document analysis. Below is an outline of how the research progressed.

6.5   The timescale of the research

1992- 2002	Experience as a mathematics teacher in bilingual and Welsh-medium classes. This experience allowed me to identify the main research issues.
2001-2003	Collection of draft LEA development plans, strategic reviews and language schemes or associated text followed by their analysis.
2001-2003	Review of central UK Government policy and the policy of the National Assembly in Wales.
2004	Reading of literature related to language planning in Wales
2004	Interviewing of mathematics teachers, followed by analysis of interview transcripts. Audio-recording of lessons, their transcription and analysis.
2005	Teachers' responses to the data.

2006-2011   Analysis of teacher responses; translating, writing up, amending and revising text; and latterly monitoring Welsh Government initiatives.

CHAPTER 7
ANALYSIS OF SCHOOL BASED INTERVIEW DATA

7.1   Introduction

I turn now to insights gleaned from my interviews with teachers working in the three schools in this study. The text for each teacher interview can be found in appendix 7. A close reading of each interview was undertaken prior to the identification of recurring themes. I have avoided giving too much detail about the schools in order to respect confidentiality. The following is a brief recap. Schools A and C were working towards making 100% of their teaching available through the medium of Welsh. School C had gone the furthest in achieving this end. School B offered a more traditional English medium curriculum; although it too was making changes by introducing units of work through the medium of Welsh for short periods of time.

7.2   Discussion and analysis of teacher interviews

In this section, we see, through the eyes of the teachers: the school policies; the evolving conditions of the teaching and learning of mathematics through the medium of Welsh or bilingually; the constraints on the development of Welsh medium and bilingual arrangements in teaching and learning; school-based debates about whether subject-specific issues or language issues should be prioritised and the teachers' own views about and lived experiences with the existing Welsh-medium teaching and learning resources.

From my detailed interpretation and analysis of the interview data I want to distil some salient points. There are the three points that came up repeatedly across the interviews. These are:

1   Mathematics Departments are attempting to formalise bilingual approaches, some are more developed than others.

2   Mathematics Departments are prioritising subject needs, resulting in limits on change.

3   There is dissatisfaction with equivalent Welsh medium resources.

It seems that, during these interviews, teachers were showing the influence of different factors in their thinking and hierarchy of priorities.

7.2.1 *Teachers' accounts of their mathematics department's bilingual approach*

I address here the first point above, that of the efforts of the teachers to formalise bilingual approaches. As I have intimated, the linguistic policies referred to by the teachers seemed to reflect competing discourses. The schools appeared to have policies that aspired towards bilingual education cast as parallel monolingualism to satisfy pupils' and parents' personal preferences. At the same time, these policies were accompanied by a discourse of bilingualism for all, in the subject of mathematics in school A and bilingualism for a few, in the subject, in school C. School B seemed to be in the process of moving from providing Welsh medium mathematics via the first route to providing Welsh medium mathematics via a form of the second route, having met with local difficulties. School A's policy showed signs of adjusting attitudes, elevating the use of Welsh in classroom interaction from "talk" to "teach" seen in A1's interview, "Sometimes the Welsh medium pupils sit together but not always em tend to leave it to them. Em and then we we talk...teach the subject eh mainly through Welsh we repeat each term anyway in both languages".

This amended status, as represented in the teacher's discourse, may have been consistent with an increased desire to cater for pupils choosing to sit mathematics examinations in Welsh. This account of school A's policy contrasted with that given by B2 in school B who reported that, during lessons in his school, pupils were spoken to in Welsh whilst teaching actually took place in English.

Placing A1's descriptions of previous and amended practice at school A adjacent to each other, one could deduce that pupils are now able to use their cultural capital more effectively, and indeed some are choosing to do this and, possibly, encountering a few complications.

Past practice:

Welsh was being used extensively in the classroom with notes and examinations tending to be given in English.

Present Practice:

Pupils are now given terms and titles in both languages.

New worksheets are bilingual and examinations are being sat in the language chosen by the pupil.

Language choice was raised in some way or another by many of the teachers. The extract below is from a narrative told by A1 who supported the amended classroom practice shown above. The extract hints at continuing social conventions of an ingrained nature. The reported comment of the pupil, at the end of the extract, who was using English texts in the bilingual classroom is especially telling. The power and authority of the teacher seems to be enhanced by him asking a question that illuminated the apparent incongruity of the pupil's position. This incongruity was reaffirmed later in the interview when A1 referred to a preference among some pupils for doing mathematics through English (though not exclusively), and to sit examinations in English.

Extract 1   Interview with A1 (The original interview was in Welsh)

DHJ: Say in key stage four then do they... is there a tendency for some to change over?

A1:   No there is no tendency there is no tendency to change over the... the... the system's the same but... and people once they have started doing it through the medium of Welsh tend to carry on eh... to eh... to the end. There are some this year in year seven and eight who have changed from English to Welsh and seen the... eh eh eh the benefit in that because I had one girl on Monday who said, "Oh I find it easier this year although I do it through English I get more terms in Welsh find it easier then" Ask then why she didn't do it through Welsh [laughter].

School B, on the other hand, was not as far along in adopting such bilingual approaches; and, instead, was formalising new bilingual policies along more incremental lines, preferring the formal, clear, separation of languages, though stopping short of arrangements in school C. The arrangements in School B are illustrated in this next extract.

Extract 2   Interview with B1 (The original interview was in Welsh)

B1: So this year we have six sets in year eight but the thing is there we have
Welsh first language speakers and then newcomers in the same class so it is just
impossible teaching them bilingually we tried it [inaudible name] and it was just
terrible it was just hopeless so we did nothing then
we just stopped so [name] said right something must be done so this year what we
thought we would do... just swap them for a fortnight and teach then through the
medium of Welsh so it worked OK.

This less positive view of the practicality of bilingual mathematics education is, of
course, grounded on experience of classroom interactions under such conditions.

In school C, C1 pointed to improvements in recent years in results for pupils in
classes that put an emphasis on Welsh resources as a result of the bilingual policy. It is
difficult to tell whether a closer match between the language of the home and the
classroom language was responsible.

However, some of the teachers' accounts downplayed the role of language in
communicating mathematics. This can be perceived from the following extracts taken
from B2's and C2's interviews. I have highlighted the relevant part in bold in C2's
extract.

Extract 3   Interview with B2

B2:   The important thing is that they are taught mathematics I don't believe the
medium is very important to an extent around here.

Extract 4   Interview with C2 (The original interview was in Welsh)

C2:   KS4 Em... We didn't have any resources we were using a lot of English books
that we have and using examples because in mathematics at
the end of the day x plus three is the same in [whatever] language so instead
of perhaps using books that are sort of not as good just for the sake of Welsh
it was better to use English books but to present it in Welsh and then
use English examples because that was the best option. But what I am

doing now very *foolishly*... I am actually translating that book with

Welsh examples I have started doing it now so then we will have

something similar we choose the best of that with the other books so we

will have in KS4... at least we will have a GCSE book for every set really and it

will work because I don't think there is one that is good enough in Welsh.

It is also possible to discern in C2's account above, a description of what could be construed as a compromise, that is less than full use of pupils' Welsh cultural capital i.e. adopting the bilingual practice of code switching supporting English texts in a Welsh medium stream. The use of the word "foolish" appears to imply that C2 is admonishing himself for doing too much or attending to comments expressed by other teachers in regard to translating textbooks.

The established bilingual policy in school C's mathematics department was that of near parallel monolingualism using identical textbooks. This seemed to be changing in KS3 with a decision to purchase new English textbooks which had not been translated, although an updated translated mathematics scheme was available. This decision seemed not to square with concerns expressed quite frequently by C1 in regard to "segregation" and "integration" which are observable in the passage below:

Extract 5   Interview with C1 (The original interview was in English)

C1:   Our biggest... my biggest eh concern I think is that the Welsh groups often seem

        to get almost forgotten on a day to day basis because... because they are in a

        minority and because [inaudible] separate from the English groups there is a

        tendency as far as I am concerned when I'm thinking about a

        year group I tend to be thinking of the English pupils in that year group more than

        the Welsh because they're almost like a separate entity and because of my lack of

        ability to speak Welsh I'm not able to perhaps to be involved in there as much as

        perhaps I would like to or should do em... so in my own mind I tend to segregate

        them a bit and think of them as separate... separate entity when perhaps we

        should think of them as being more integrated.Whereas often of course because

        of... they might be using different resources they have their lessons obviously at

different times when you know everybody in year nine might be having maths on the English side it will be different on the Welsh side and so you tend to again think of them as being separate entities from that point of view... that's my main feeling.

C1's concern was based on his personal views, and experience, which was marked by the change from the plural "our" to the singular "my" possessive adjective.
The decision to purchase new English textbooks may have squared with attempts to reassert normal linguistic markets, and ensure the English medium streams appeared attractive to parents and pupils. The accounts given here by the teachers seem to reveal that practice was tending to diverge further from formal linguistic policy.

7.2.2   *Teachers' accounts highlighting the needs of their subject*

My second point is related to departments prioritising subject needs and subsequently placing limits on change. The discourses drawn upon by the teachers appeared to embody the local formula for funding the development of bilingual education. Although an opportunity for Welsh speaking pupils to use their cultural capital more effectively was appraised in school B-reasons against socio-linguistic change were elevated and linked to standards and complexity to add gravity to the case for stability, this can be appreciated from the following extract.

Extract 6   Interview with B1

DHJ: Next question if your classes are divided along language lines what are the
         advantages/ disadvantages?

B1:   Just on language... so Welsh in one class and eh... in maths I believe that the spread
         is too much because we looked at one time at just dividing into
         sets to have Welsh sets one two three and English sets one two three and I compared
         the two sides and on the Welsh side there isn't much of a problem because we have a
         lot of clever children there because there are good learners in the Welsh classes
         anyway but on the English side in the [inaudible]...when I did the sorting out in the
         English set one... if I used children we had at the time then there were children from

set one to set four in one class so because I had three tiers at GCSE and in the SATs that was... we just couldn't raise standards with such complicated sets really.

This less positive view towards operating three streams in both Welsh and English in school A, contrasted with the actual system School C was running of just one or two Welsh medium streams in each year and around six English medium streams. In school C, there was an appreciation that the wide range of abilities in some Welsh medium classes, created by wider access policies, had to be alleviated, as in the interview with C1. But C2's description of a teaching strategy to cope with the nature of the classes, suggests complexities that support B1's concern over mixed ability teaching.

On a few occasions, the power of the linguistic market made itself apparent as in the paradoxical discourse of B1 who chose to elevate the effective use of cultural capital to support reverting to English first language teaching away from a bilingual approach. This is discernable in the next extract.

Extract 7   Interview with B1

B1:   I think its worked OK but with the Bs after we did everything
         in Welsh up to Christmas and then I thought... right... so we are going to turn to
         English and I believe they find it easier in English because they are learners so
         and with these books sending them home to do homework because the parents
         couldn't read Welsh if they have a problem doing the homework because the
         excuses "no we can't read the question [noun]" I didn't know what to do so... so
         that was a slight nuisance really.

7.2.3 *Teachers critiquing Welsh medium mathematics resources*
         Moving on to the third point I want to consider, that of dissatisfaction with
equivalent Welsh medium resources, many of the interviews contained negative
comments in regard to Welsh medium textbooks. These came from teachers in school B
and school C. A1, however, seemed to be more content to use translated books.
The following extracts are all indicative of the teachers' criticisms,

Extract 8   Interview with B1

B1:   Right we bought Allwedd mathematics books... these for year seven... but on

comparing these with what is in the English they have too much writing on one

page... they are not *user friendly really*. So I began last year to try and do

something different so I have prepared those [pointing to materials the teacher had

prepared herself] so [name] translated them he translated everything I had in

English.

Extract 9   Interview with B2

B2:   I'm fortunate I've only taught the first language [another teacher] has been

teaching the good learners so the only thing we had to get perhaps were books...

we got books eh... Allwedd but unfortunately I think they are not suitable books

for the Welsh the language is too difficult you know the language is difficult if it

was in English anyway

Extract 10   Interview with C2

C2:   and there are a lot of examination papers... examination questions in these and

what happens is that they need to know so if I [need] to start GCSE and I sort of

need to do a question I've got to teach something and something else and then it

isn't... it isn't easy to teach using these... the only books are the SMP [School

Mathematics Project] books... once again SMP has problems because they jump

too much from place to place and also there are different books. And Vickers...

they've made Welsh books but the problem with Vickers is also [inaudible] books

six seven eight nine and A star and the problem is... if it's fifteen pounds a book

well... to teach one pupil in a class you are talking sixty pounds and that isn't... no

one can afford this.

These discourses, may have been closely related to the emphasis on the 'local' that can

be perceived in some educational literature. Teachers C1, C2 and B1 were engaged in

the production of local resources for mathematics. This was actually required by local

management in the case of school C. All were having difficulty in adopting

standardized Welsh material in some way, although somewhat paradoxically, C2 seemed willing to share the locally produced resources with other teachers. This willingness to contribute resources towards the teaching of others, echoed a trend in education in Wales at the turn of the millennium to encourage teachers to create their own Welsh resources and share them by sending them to a centrally managed pool. This led to the development of a veritable cottage industry. Of course, this development ran counter to the production of high quality standardized material.

7.3 Chapter Summary

In this chapter, I have drawn attention to three main themes emerging from the interviews with the teachers:

1)   The school policy on bilingual education and the impact this had on their classroom practice.

2)   The competing demands of the subject of mathematics and the specific bilingual policy of the school, with some teachers prioritising the demands of their subject.

3)   Their critique of the Welsh medium mathematics resources available.

My purpose has been to reveal the teachers' own perceptions of the policy conditions in which they were working; the constraints and challenges they faced and their concerns about the resources available to them to create Welsh medium or bilingual spaces in the teaching and learning of mathematics. In the next chapter, I will take a closer look at the ways in which the concerns and understandings of the teachers in two of the schools (School A and C) were reflected in classroom practice and in day to day interactional routines in mathematics classes.

CHAPTER 8

CLASSROOM INTERACTIONS

8.1   Introduction

This stage of the research was guided in part by the findings of Ball (1981), as he compared the different interactions and relationships that occurred when pupils were observed in classes determined by a banding system with those that occurred when pupils were organised under a mixed ability system. As we have seen, Ball became aware of the domination of working class pupils by their middle class peers and how this act of domination contained the aspirations of many working class children especially in a mixed ability context. The work of Jaffe (2003) in Corsican schools also provided some guidelines for analysis. She identified some pedagogical practice as being connected with the negotiation of cultural and linguistic identity and the management of "sameness and difference". She drew attention to similar patterns of participation and non-participation to those identified by Ball at Beachside.

8.2   The collection and management of classroom data

Twelve lessons were recorded at School C, followed by recordings of six lessons at School A. In all, six different teachers were observed. Samples of the transcripts of the lessons are arranged in order in Appendix 8. Each teacher, apart from one, was observed during three successive lessons, and Table 2, below, outlines the teaching approach used by each teacher and also the extent of the audio-recordings, lesson observations and transcriptions.

Table 2. Schools A and C: Audio-recordings, observations & transcriptions

Schools	Teachers	Type of provision	Audio-recordings (A), observations (O) and full transcription in Appendix 8 (Tr)		
			Lesson 1	Lesson 2	Lesson 3
A	A1	Bilingual approach	O A	O A	O A Tr
	A2		O A	O A	O A Tr
C	C1	English medium stream	O A	O A Tr	O A
	C2	Welsh medium stream	O A	O A Tr	O A
	C3	English medium stream	O A	O A Tr	O A
	C4	Welsh medium stream	O A	O A Tr	O A

In the transcripts, I have used italics to highlight a change of code during the lessons (see list of transcription conventions). To complement the audio recordings, I took notes during each of the lessons using a pro forma, which allowed me to identify salient communicative features and to record the periods of time in which they occurred. This also provided me with a uniform structure for note taking. The pro forma can be seen in Appendix 9. I explained the notes I was taking to each of the teachers involved in order to keep them informed.

8.3   Questions for the analysis of data

For the analysis of the data, I will concentrate on the following questions to guide my way through the data and also contrast the ways of working in each school.

1) How much switching between languages is there in the classrooms? What kind of meanings are generated through this switching?
2) How is the value of Welsh and of English being constructed in and through the interactions?
3) What kind of language resources are used in Welsh and in English?
4) What approaches to teaching are observable?
5) What kind of pupil participation occurs?
6) How is mathematics communicated?
7) How do Welsh medium, bilingual and English medium classes compare?

8.4   Analysis of data from School A

8.4.1 The lessons given by Teacher A1

Prior to discussing the lessons given by teacher A1, I want to give some attention to the nature of the class and an impression of the circumstances for learning. Teacher A1 met me by the school entrance, and introduced me to the head teacher of the school who happened to be out on the corridor. We then made our way, via some steep, narrow stairs, to the mathematics department. There were posters outside the room, which indicated the relevance of mathematics to everyday life and further study. After finding a convenient,

and unobtrusive position at the side of the class, I drew diagrams of the seating positions in all classes, the form for which can be seen in the appendix along with the classroom observation pro forma. After the pupils had settled, I was introduced to the pupils who were informed I would be audio-recording the lessons during the week. A1 reassured the pupils about the use of the recorded material. The year 8 group I was observing was the second set out of five possible sets in Year 8. A1 told me that the total number of pupils in the year was about 100. During the week the highest number of pupils in A1's class was 22. No additional linguistic support was given to pupils in the class, which suggested strongly that the school had assessed the pupils as competent speakers of Welsh. Posters adorning the walls of the classroom included some that were in Welsh. The resources for teaching, however, seemed dated. In particular, the rolling blackboard harked back to past traditions.

The mathematical topic introduced by A1 to be taught during the week of my visit was algebra, set at level 5 of the National Curriculum (NC). Initially, pupils were asked to simplify expressions involving two unknowns by adding or subtracting similar terms. Teacher A1 employed a number line, marked on the side of the board, during the lessons to help the pupils to develop understanding. The first lesson progressed to algebraic expressions involving multiplication, with much of the interaction being of a whole class nature. This lesson was mostly in Welsh, but with some instances of code switching that I recorded on my observation sheet. What was quite noticeable, however, from the audio-recording was the absence of a context to guide the learning of the pupils, I will raise this again during the more detailed description of classroom developments that I now undertake.

At times, during the first Key Stage 3 lesson, it was possible to discern the adherence of the teacher and some pupils to a set of language values in their discourse practices in this classroom. These values meant that some pupils chose English terminology ahead of Welsh terminology more frequently. This adherence to a set of language values can be seen quite easily during a passage of explicit talk about mathematical language from line 148 to 168. Martin's (2003:35) study of interaction in a multilingual classroom in Brunei reviewed in chapter 2, captured a similar practice, which was described as the 'positioning' of English as "the most preferred language". A1

explained that there were many equivalent words in mathematics to describe the process of "taking away" in both Welsh and English, and that there was no difference between them.

Extract 1 Lesson 1

A1:   Ie. Rho dy law lan i fi te. [P] Ie? Os da chi yn cytuno rho dy law lan [Aneglur] reit *good* neb yn anghytuno oes e? [P16] hapus? Reit wyth so... ni lan fana yn dechre tynnu deg... ni mynd lawr i dau *minus* dau a ni'n tynnu chwech arall. Yr un peth da ti [P1] reit unwaith ti di tynnu y deg bant o'r wyth ti lawr i *minus* dau yn dwyt ti so wedyn *take away* dau so... wedyn yr un peth da ti fana

wedyn ti dechre fani *take away* neu *minus* chwech a yn dyfe OK. Cofiwch fel dwi di dweud does dim gwahaniaeth yr un gair yw *minus* a *take away* jest gair arall am y broses i chi wneud yw e... OK tynnu ffwrdd *take away minus* minws... oes rhywbeth arall chi'n defnyddio?

P: *Subtract.*

A1:   *Subtract* ie iawn ydy... mae nhw gyd yr un peth ydyn... ti'n eithaf reit

P: Oes rhywbeth... oes rhywbeth fel wniwns wynws neu rhywbeth?

A1:   Minws.

P: Ah minws.

A1:   Minws ie. Fi ddim yn lecio'r gair minws fy hunan *minus* wi'n gweud na fe.

P: *Decrease.*

A1:   Mm?

P: *Decrease.*

A1:   *Decrease* ie elli ti defnyddio *decrease*... ie ie... ti'n iawn ti'n iawn ie ...mae'n anodd i ddweud *decrease* pan ti'n darllen *minus* yn dyw e na'r unig beth ond arwahan i hynny ti'n iawn ti'n hollol iawn fel i'n ni'n

Translation:

A1:   *Yes put your hand up for me [P] Yes? If you agree put your hand up [inaudible]Right good no one disagrees do they?[P16] happy? Right eight so... up there to start subtract ten... we go down to two minus two and we take another six. The same thing with you [P1] right once you've taken the ten away from the eight you're down to minus two aren't you... so then take away two so... then you*

have the samething there then you start there take away or minus six a OK.
Remember as I have said there is no difference.. minus and take away are the
same word they are just different words for the process that you do OK [tynnu
ffwrdd] take away minus [minws] is there anything else you use?

P: *Subtract.*

A1:   *Subtract Yes correct yes... they are all the same yes... you're quite right*

P: *Is there something... is there something like [wniwns wynws] or something?*

A1:   Minws.

P: Ah minws.

A1:   Minws *Yes. I don't like the word [minws] myself I say minus there you*
        are.

P: *Decrease.*

A1:   Mm?

P: *Decrease.*

A1:   *Decrease Yes you can use decrease... yes yes... you're right you're right yes... it's*
        difficult to say decrease when you read minus isn't it that's the only thing but
        apart from that you're totally right as we say with a thermometer of course.

As we can see from the extract above, pupils were asked to say other words they used to describe the process of taking away. One pupil volunteered the higher order word "subtract", which was given several positive evaluations by A1. This was followed by a contribution by another pupil. The pupil asked whether there was something like [wniwns] (sounding like onions). A1 recognised these word plays and supplied the standard Welsh term. However, A1 did not evaluate "minws" positively, contradicting what had been said previously regarding the equivalence of different words. A1 expressed a dislike for the Welsh pronunciation and therefore the standard Welsh term and made clear that his preference was for the standard English term. Following this clarification of the context, another pupil volunteered the word, "decrease" which was given several positive, though less fulsome evaluations by A1.

It is difficult to interpret whether the pupil who proposed the standard Welsh term 'minws' was doing so with conviction or in jest. It is possible that it is the latter, because

of the link made with 'onions'. However, the teacher's explicit preference for the English term set the tone for the class, since this was a statement from a position of authority. Other similar talk about terminology, at other moments in the three lessons that I observed being taught by this teacher, contributed to the construction of English terminology as having greater value than the equivalent Welsh terms.

Language values were also foregrounded when A1, asked for an English equivalent to the Welsh term "lluosi" [multiply]. In addition to providing the term 'multiply' the children favoured the term "times" instead of "gwaith". A1 then goes along with the children's language preference, endorsing it. I include the relevant passage below because it illustrates clearly the children's orientation to English and teacher accommodation of this.

Extract 2 Lesson 1

A1:   Pa air y chi'n defnyddio am lluosi?

       Which word do you use for [lluosi]?

Ps: *Multiply*.

A1:   *Multiply* rhyw air arall?

       Multiply *any other word?*

P: *Times*

A1:   *Times* ni'n neud *times* ydyn ni ydyn

       Times *we use/say times yes we do*

A1:   Ni'n neud gwaith yn Gymraeg. Oes rhywun yn gweud pedwar gwaith pump? Na? Clywed hwnna? Eh *multiplying*. **['Multiplying' written on board next to Lluosi]**

       We do/say [gwaith] in Welsh. Does anyone say four [gwaith] five? No? Heard that? Eh multiplying.

Despite his orientation to and valuing of English terms, A1's commitment to bilingual lessons was apparent from his attempts to use English and Welsh terms together, as in setting problems bilingually by producing bilingual worksheets and using

English and Welsh terms together as in the extract above and at other times in lesson 2 and 3.

There was a clear emphasis on oral work during each lesson. At times, A1 appeared to be scaffolding English terms by the use of Welsh, for example, in lesson 1 an assessment routine involved English terminology and was followed by an explanation in Welsh.

Extract 3 Lesson 1

P12:   Wel.

      Well

A1:   Be wnes ti?

      What did you do?

P12:   O'n i wedi *timsio three by two* a wedyn *four* a'r tri.

      I timesed three by two *and then* fou*r and the three*

A1:   So be ges ti pan wnes ti *three by two*.

      So what did you get when you did three by two

P12:   *Six*

A1:   *Six* be?

      Six what?

P12:   *Six* a b.

A1:   *Six* a b ie.

      Six a b yes

P12:   A wedyn *twelve* a b a wedyn

      And then twelv*e a b and then*

A1:   *Good*. Stopa di fana am funud. Ie gret ffantastic. Reit chi'n gweld be wnaeth hi tri

      a lluosi dau b a lluosi hwnna gyntaf a creu chwech a b a wedyn fe luosodd hi

hwnna pedwar a *times* tri b i gael deuddeg a b un deg dau a b so mae da hi lot o a

bs fana i gael a lot o a bs mae'n adio nhw a'u gilydd a cael un deg wyth yn dyfe.

Pwy gath un deg naw? Fel na wnes ti e?

Good. Stop you there for a minute. Yeah great fantastic. Right you see what she
did three a multiply two b multiply that first to create six a b then she multiplied
that four a time*s three b to get twelve a b (repeats using modern convention of*
Welsh numbering) so she has many a bs there to get a lot of a bs she adds them
together to get eighteen isn't it (Welsh slang). Who got nineteen? That's how you
did it?

In the second lesson, there were long sections where Welsh was used
independently of English by pupils and A1 to answer a question, and this was followed
by a long Welsh numbering sequence. This pattern was inverted in the final section of the
lesson with English numbering used by the pupils involved in an assessment routine.

The language of teaching and learning varied, with initiation/response/evaluation
(IRE) routines sometimes occurring with English numbering and terms, and sometimes
with Welsh terms. The latter pattern, however, was broken occasionally by individual
pupils turning to English numbering. These routines allowed A1 to assess the
understanding of some pupils. The use of small white boards by the pupils during the
lessons, for example in lesson 3, broke the repetitive nature of the routine and allowed A1
to conduct a more complete assessment of the class as can be seen in the extract below.

Extract 4 Lesson 3

A1:   Ie. Reit te wnawn ni cwpl bach ar byrddau to i jest cael gweld a wedyn wnawn ni

tipyn bach o rannu. Reit dim ond tri bach wi am wneud nawr. *Quick fire* nawr. Eh

minus two a *times minus three* b. Ar y byrddau.

Yes. Right then we'll do a couple of small ones on the boards again just to see and

then we'll do a little bit of division. Right I'll do only three small ones now. Quick

fire *now.* Eh minus two *a* times minus three *b. On the boards.*

Ps: Oh.

A1:   Wedes i ar y byrddau.

         I said on the boards

A1 helps individual pupils.

 A1:   Siwr abyti hwnna? Siwr abyti hwnna? Ie. Siwr? Pam ti'n rhoi *minus* tu blaen?

         Mm.

         Sure about that? Sure about that? Yes. Sure? Why have you put minu*s in front?*

         Mm.

         The method therefore contributed towards reducing the opportunities for pupils to participate in long numbering routines either in Welsh or in English.

         At this point, I decided to look more closely at the use of terms by A1 and pupils in lesson 3. The tables below show the frequency of terms in Welsh and in English and who used them.

Table 3: The use of Welsh terminology in teacher A1's third lesson

Welsh Term	Teacher A1	Pupils
Lluosi	28	0
Gwaith	0	0
Tynnu	7	0
Rhannu	13	2
Symleiddio	8	0

Table 4: The use of English terminology in teacher A1's third lesson

English Term	Teacher A1	Pupils
Multiply	0	0
Times	28	7
Subtract	0	0
Minus	27	12
Plus	9	5
Simplify	1	1
Divide	0	0

A slight disparity emerges as the mathematical terminology during pupil interactions in the classroom was weighted towards English terms. In this lesson, Welsh terms, were employed, in the main, by the teacher. Pupils choosing standard English terms appeared to have greater control of the conversational floor of the classroom.

IRE routines are usually described as teacher dominated, although in this class, there were instances where the IRE routine was reversed when pupils initiated conversations. The normal IRE routine allowed A1 and pupils to construct with the students an algorithmic method of tackling mathematical problems, as shown below (and seen in other lessons):

Extract 5: Lesson 1

A1:   Reit… a P4.

    Right… and P4

P4:   Un a a tri b adio tri b

    One a and three b add three b

A1:   Ti'n siwr mai adio tri b wyt ti'n wneud?

    Are you sure that you add three b?

P4:   Tynnu *minus*.

    Take away minus

A1:   Tynnu *minus* yn dyfe achos mae pedwar b gyda ni ni'n dechrau lan fana

ni'n tynnu saith so ni'n mynd lawr ni'n gorffen lan yn *minus* tri b OK.

Take away minus *isn't it because we have the four b we start up there we take*

away seven so we go down and end up at minu*s three b OK.*

In this respect it may have been an effective and possibly egalitarian way of teaching, making the most of the teacher's mathematical experience. Teacher A1, however, was not alone in adopting this method. The method appeared in most of the classes observed during this study.

I mentioned earlier the apparent absence of a context to support the learning of the pupils during lessons. A1, however, did, on one occasion, use a context to address the concerns of pupils as in lesson 3 where he referred to a thermometer and Siberia in relation to directed numbers.

In these lessons at KS3, led by A1, the positioning and status of Welsh appeared to vary considerably and this variation was due to the challenge of classroom management in a class with pupils with different language abilities. There were times when Welsh was given equal attention to English in knowledge building around mathematics. Nevertheless, as we saw, there were instances where Welsh was recast less positively.

8.4.2 The lessons given by Teacher A2

Teacher A2 had recently been appointed to the senior management team of the school. On the first day of my observations A2 greeted me at the school reception and began to describe the year 10 class as we made our way to the classroom, which was situated in what appeared to be a newer building. On the way to the lesson, A2 highlighted one pupil, P1, who was considered a good learner but also a "character". On entering A2's class, the first impression was that the resources for teaching were of a higher specification than those in the previous class, with an electronic white board being put to use. I observed A2 teaching the three lessons in this same classroom, but A2 made clear that another classroom was sometimes used. The theme for the week's lessons was handling data at level seven of the National Curriculum although lesson 2 deviated from

this to concentrate on some elementary fraction work, as A2 felt that this aspect of the pupils' mathematical development was in need of attention.

There were twenty seven pupils in the class. Three of the pupils were taking mathematics through the medium of Welsh at GCSE level the following year, while twenty four were taking mathematics through the medium of English. In practice this meant that the pupils were allocated resources such as books and worksheets in the language they had chosen. The pupils were being prepared for the intermediate tier examination at GCSE.

During a pause in the first lesson, whilst pupils were working individually, A2 shared with me her views about bilingual approaches to teaching and learning. She said an aim during mathematics lessons was to keep the two languages separate rather than mixing them, in this way 'respecting' both languages. A2 also informed me that between 10% and 15% of the pupils in each year were pupils who were placed on an accelerated programme called a "Cwrs Carlam" (Accelerated learning course) and that subjects such as Geography and History had additional language support for these children. A2 also told me the school was starting a Welsh medium stream in mathematics and that A2's approach would be to support the pupils in both languages as the stream had "Carlam" pupils.

During my observations of A2's three lessons, I recorded regular instances of code switching and a substantial amount of teacher led interaction. The classroom interactions included moments when pupils and teacher were conversing in Welsh around English terminology. This was not always the case, however, as on some occasions, such as the beginning of lesson 3. Welsh terminology was introduced for quite long periods and in isolation from English terms. It should be noted that at this time of significant Welsh terminology use in lesson 3, teacher A2 used the word "ofni" [afraid] on three occasions in relation to the pupils' diffident response to initiations. This diffidence may also have coincided with a more demanding level of mathematics for the pupils. This diffidence represented a significant departure from the usual level of participation observed during different knowledge building events recorded over the course of the three lessons given by A2. See the three extracts below:

Extract 6 Lesson 3

A2:   OK. *Part c somebody else please*. For the cyfwng dosbarth ble mae'r canolrifau?

        Chi [ofni?] gweud wrthai? P2.

Translation

A2:   OK. Part c somebody else please. *For the class interval where is the median?*

        You're[afraid?] to tell me? P2.

Extract 7 Lesson 3

A2:   Cant dau ddeg pump litr na ti a wedyn b rhywun arall plis. [rwy'n gweld atebion o

        blaen chi'n ofn ofni dweud ?] P12 oes ateb da ti?

Translation

A2:   *One hundred and twenty five litres there you are and then b someone else please.*

        [*I see answers before you're afraid afraid to say*] P12 do you have an answer?

Extract 8 Lesson 3

A2:   Chi'n ofni'r gwaith ma yn fwy na dim yn dy'ch chi. a b *the next part part b four
        point zero seven c* nawr mae hwn yn gofyn am y dosbarth modd *the modal class.*

Translation

A2:   *You're afraid of this work more than anything aren't you.* a b the next part part b
        four point zero seven... c *now this asks for the mode* the modal class.

As it transpired, one pupil dominated the turns taken by the pupils over the course of the three lessons. It also became apparent, over the course of the week, that this pupil could converse with A2 in Welsh, but appeared more confident in English.

Despite the views about treating Welsh and English equally expressed early on to me, away from the floor of the classroom, A2 made the ambivalence of her own language values explicit on one occasion by stating to all the pupils that the Welsh equivalent for the word 'a third' was redundant in her own everyday life. A2 then continued the

discussion about fractions and decimals by using Welsh numbering for decimals. This apparent inconsistency can be observed in the extract taken from lesson 2 below

Extract 9 Lesson 2

A2:   *Three* tri dros ddeg ti'n iawn tri dros ddeg yw hwnna. Mae'n agos wrth gwrs i draean na'r gair Cymraeg am *one third*...traean... ond fi ddim yn defnyddio fe yn bywyd bob dydd ti byti bod yn iawn ond yr ateb yw dim pwynt tri tri tri tri mae o'n cario mlaen am byth a gallwch chi roi dot uwchben y tri cyntaf smo ti'n anghywir ti'n iawn a ti gafodd gyntaf beth bynnag ond ti'n gallu rhoi y dot yn syth uwchben yr un sy'n ailadrodd. Chi da fi P1?

Translation:

A2:   Three *three over ten you're right that's three over ten. It's close of course to a traean that's the Welsh word for* one third...traean... *but I don't use it in everyday life...you're almost right but the answer is nought point three three three three it carries on for ever and you can put a dot above the first three you're not wrong you're right and you were first whatever but you can put the dot directly above the one that's repeating. You with me P1?*

In the final line, A2 attends to another concern, that of supporting a less developed speaker of Welsh, P1.

I turn now to a more detailed account of how language use varied in A2's lessons. She employed an array of pedagogic strategies from Welsh medium teaching, scaffolding using English, scaffolding using Welsh and English medium teaching.

The classroom interaction across all of A2's lessons was, in the main, in the familiar three-part IRE form. Even though A2 used both languages in many of her initiations, the initiations seemed to be geared towards English responses by, paradoxically, placing English second. This might have been be related to the language choices made by the pupils for their GCSE examinations. Here are just two examples from lesson 3.

Extract 10 Lesson 3

A2   Na ti pedwar lan i pedwar pwynt pump yn dyfe mae'n cael ei sgrifennu lawr fel hyn *four less than or equal to h less than strictly less than four point five.* So na

hwnna mae un rhan arall d y cyfwng dosbarth canolrifol ble mae hwnnw? Ble

mae'r where is the eh class?

Translation:

A2:   *There you are up to four point five isn't it. It is written down like this* four less

than or equal to h less than strictly less than four point five. *So that's that there is*

one other d the median class interval where is that? Where is Where is the eh

class.

Extract 11 Lesson 3

A2:   *Eighteen* ie mae'n dibynnu fel ma faint mae'n dweud. Reit mae[inaudible] yn

sefyll am hyd gad i fi gweld be mae hwn yn siarad abyti mae tabl hwn hyd y ceir

reit l *therefore stands for the length of the cars* h hyd y ceir. Nifer y ceir mae'n

defny defnyddio yn eich llyfrau chi amledd neu *frequency* siwr o fod iawn nifer y

ceir number of cars canolbwynt byddai'n rhoi mewn fan hyn mid-point a wedyn

yn y darn olaf byddwn ni'n lluosi nifer y ceir gyda'r canolbwynt *multiply the*

number of cars by the mid-point. OK nawr te P4 *what is the mid-point in the first*

class interval? Mid-point between three and three point five.

Translation:

A2:   Eighteen *Yes it depends as how much does it say. Right the [inaudible] stands for*

length let me see what this is talking about. This table length of cars right l

therefore stands for the length of the cars h *length of the cars. Number of cars it*

use uses in your books amledd *or* frequency *bound to be right. Numberof cars*

number of cars *mid-point I'll put in here* mid-point *and then in the last part we*

will be multiplying the number of cars with the mid-point multiply the number of

cars by the mid-point. OK *now then P4* what is the mid-point in the first class interval? Mid-point between three and three point five.

Consequently the small number of Welsh medium pupils preparing for GCSE exams had fewer initiations to use the language they preferred in the mathematical domain. Notwithstanding this, Welsh had a role within the class. Welsh mathematical terms were being introduced, sometimes independently, but much of the use of Welsh involved classroom management whilst it appeared that serious mathematical problems were discussed solely in English, as seen below:

Extract 12 Lesson 3

A2:   Y ceir i gyd na ti faint yw hyd y ceir i gyd felly be ti'n wneud nawr te i ffeindio'r

cymedr to find the mean what do you do?

[*All the cars there you are. What is the length of all the cars therefore?What do*

you do now to find the mean to find the mean what do you do?]

Px: *Four hundred and seven divide by a hundred.*

A2:   *Four hundred and seven metres divided by a hundred* a sdim eisiau cyfrifiannell

[*and no need for a calculator*]

Px: *Four point o seven.*

A2:   *Four point zero seven metres.* Wrth gwrs wnes i ddim trafod heddi cyn dechrau

beth fydde chi'n amcangyfrif iddo fe fod. Dyma le mae'r ateb yn agos iawn i'r

dechrau y dosbarth hyn. Agos iawn i'r dechrau. *You see most of the cars are in*

here. Sdim lot o geir yn fwy *so the mean is just in there four point naught seven.*

Be mae'n gofyn P4?

[Four point zero seven metres. *Of course I didn't discuss today before starting*

what you would estimate it to be. This is where the answer is very near to the

beginning. You see most of the cars are in here. *Not many cars are bigger* so the mean is just in there four point nought seven. *What does it ask P4*]

P4:   *Modal class.*

A2:   *Modal class most popular class.* Shsh allwch fi'n gwybod bod chi'n weithgar os gallwch chi cadw'r swn lawr tamad bach. P8 *what is the modal class*?

[Shsh *can I know that you are hard-working if you could keep the noise down a little.* P8 what is the modal class?]

P8:   [Inaudible]

A2:   Ie yr un hwn. Achos mae hwnna yn golygu *most popular.*

[*Yes this one. Because that means* most popular]

P: *Group.*

A2:   *Class.* Mo yn mynd ym modd a mode. *And finally part d median class interval OK. How do we go about that? How many cars did we have all together?*

[Class. *Mo goes em modd and* mode]

P: *Hundred.*

A2:   *Hundred. If you put the cars in order from the shortest to the longest is there going to be a a one middle car.*

P: *No*

A2:   *No. Ok so what do you do? This is now part d.*

P: *Fifty and fifty one.*

A2:   *We divide hundred by two to get fifty so it's the fiftieth and the fifty first that we are looking for. Now where are they? We've got twenty one cars up to there. How*

many cars do we have we have thirty five cars up to there. How many cars do we

have which are still less than four point

P: *Eighty seven.*

A2:   *Eighty seven and therefore where is the fiftieth and the fifty first where are they*

going to be? In which class?

Ps: [Inaudible]

A2:   Yeah *same class again*. Felly P4 ti ofynnodd i mi gyntaf wyt ti'n teimlo chydig yn

fwy hyderus a byddi di yn gallu mynd nôl a ceisio rhif pedwar wel a un falle ie?

[Yeah same class again. *So P4 you asked me first do you feel a little more*

confident and you'll be able to go back and try number four well and one perhaps

yes?]

Other examples of scaffolding in Welsh of English terminology as a teaching method were observed. A contribution by pupil P1 in lesson 1 was followed by an explanation in Welsh by A2 to the others in the class.

Extract 13 Lesson 1

A2:   Adio gwed ti wrthai i ti'n alreit.

[*Add you tell me you're allright*]

P1:   *Well em take away the threes and just divide eh divide five by two.*

A2:   Reit na un ffordd. Chi'n gwybod beth mae P1 yn dweud wrtho chi mae'n dweud

tynnu hwnna mas o hwnna i gael pump rhannu hwnna gyda dau i gael? *Divide*

five by two.

[*Right that's one way. You know what P1 is saying to you. He's saying*

*subtract/take away that from that to get five divide that by two to get?*Divide five

by two.]

P: *Two point five.*

This method was adopted at other times to explain English text; but it should be noted that interactions did occur in Welsh mainly and a summary then given in English.

As I indicated earlier, school A had adopted the use of small white boards for pupils to write down their answers during lessons. This tool, which the pupils obviously found stimulating, may have been a way of changing classroom interactions so that more widescale participation could occur and so that dominance by a few pupils could be avoided. In A2's lessons, however, it was apparent that there were times when this strategy was less effective, with appeals being made for pupils to use their white boards, rather than calling out their answers. P1, in particular, the student who preferred English, strayed from the usual method of using the white boards, perhaps sensing that this resource was changing the linguistic interactions.

The step by step, algorithmic approach to constructing a mathematical answer to a problem was also evident in A2's lessons, as can be seen from this next extract from lesson 3 line.

Extract 14 Lesson 3

A2:   Iawn. Nawr shsh Beth mae hwnna' n golygu ar y funud. Dwi moen i chi edrych

        ar y golofn olaf. Beth yw ystyr y cant? Mae gyda chi gant.

P: O geir.

A2:   O geir. Beth yw ystyr pedwar cant a saith. Dyna

Px: *Frequent* na Amledd *times* canolbwynt. **[Px=The same unidentified pupil]**

A2:   Ie. Be mae'n dwi'n cytuno be ti'n dweud ond elli di roi fe mewn geiriau bob

        dydd. Beth yw ystyr y pedwar cant a saith? Pedwar cant a saith beth yw?

Ps: *Metres*.

A2:   Ie na ti. Nawr te mae'n bedwar cant a saith metre felly be mae'n golygu? Mo

        belled a'r ceir yn y cwestiwn beth mae'n golygu?

Px: Faint yw hyd e.

A2:   Faint yw hyd?

Px: Y car.

A2:   Y ceir i gyd na ti faint yw hyd y ceir i gyd felly be ti'n wneud nawr te i ffeindio'r

cymedr to find the mean what do you do?

Px: *Four hundred and seven divide by a hundred.*

A2:   *Four hundred and seven metres divided by a hundred* a sdim eisiau cyfrifiannell

Translation

A2:   *Right. Now shsh. What does that mean at the moment. I want you to look at the*

final column. What is the meaning of the hundred? You have a hundred

P: *Of cars*

A2:   *Of cars. What is the meaning of four hundred and seven. That's*

Px: *Frequent no frequency times mid-point* **[Px=The same unidentified pupil]**

A2:   *Yes. What does I agree what you say but can you put it in everyday words. What*

is the meaning of four hundred and seven what is?

Ps: *Metres.*

A2:   *Yes there you are. Now it's four hundred and seven metres so what does it mean?*

As far as the cars in the question what does it mean?

Px: *What's its length.*

A2:   *What length is the*

Px: *The car.*

A2:   *All the cars there you are the length of all the cars therefore what do you do now*

to find the mean to find the mean what do you do?

Px: *Four hundred and seven divide by a hundred.*

A2:   *Four hundred and seven metres divided by a hundred no need for a calculator*

These IRE patterns were sometimes inverted as pupils initiated the conversations. A2, however, showed an ability to turn such initiations around and re-establish the social order.

There were occasional indications that attempts by A2 to provide Welsh medium education were being met with less than total cooperation from some pupils. Following teacher turns involving significant Welsh input, pupils had to be asked for attention as in this example from lesson 1.

Extract 15 Lesson 1

A2:   A'r cant a'r unfed. *Right the hundredth and the hundred and [oneth?].* Shwd i ni

        mynd i ffeindio wel welson ni chwech erbyn bod ni di gorffen y dosbarth ma.

        Faint sydd gyda ni lan at fan hyn?

        [*And the hundred and first*. Right the hundredth and the hundred and[oneth *?]*

        How are we going to find well we saw six by the end of this class. How many do

        we have up to here?]

Ps: Un deg pump Un deg pedwar un deg pedwar.

        Fifteen Fourteen Fourteen

A2:   P15 problem da adio bore ma. *So the first second third fourth fifth and sixth are*

        in there. Wnewch chi wrando achos wi'n gwybod bod rhai o chi ddim yn deall

        hwn. Wi'n rhoi y rhifau ma lawr a fi gwybod bo chi ddim yn siwr be mae hon yn

        siarad abyti. Felly *the first second third fourth fifth and sixth are in here. The*

        seventh eighth ninth up to the fourteenth time are in there. Then we have the

        fifteenth up to where?

[*P15 have you a problem adding this morning.* So the first second third fourth

fifth and sixth are in there. *Will you listen because I know some of you don't*

understand this. I'm putting these numbers down and I know that you're not sure

what I'm talking about. Therefore the first second third fourth fifth and sixth are

in here. The seventh eighth ninth up to the fourteenth time are in there. Then we

have the fifteenth up to where*?*]

Eventually, in lesson 3, A2 appeared to signal that the bilingual approach would

be stopped at some point. However, a pupil, interrupted before A2 could expand on the

reason. In due course, A2 changed from the bilingual approach and adopted a

monolingual approach. This occurred towards the end of the lesson, where scaffolding

was withdrawn during an explanation provided in response to a question.

8.5   Analysis of data from School *C*

8.5.1 The lessons given by Teacher C1

School C was situated in a small rural town and it was difficult to believe it could

sustain a large comprehensive school. At the end of the school day, however, the number

of buses that queued to take the pupils home was impressive, and reflected the fact that

pupils were coming to the school from urban as well as rural areas and accounted,

therefore, for the apparent incongruence.

When I arrived at school C, I had to register at reception according to the school

security system. Whilst I waited to be greeted by the head of department C1, my eye was

drawn to a poster placed to the side, but facing visitors sitting at reception. This poster

quoted a passage from the document "Iaith Pawb" [Everyone's language] (2003) that

attempted to define bilingualism as the right to use one language only or a combination of

two languages. This definite statement from an external body (The Welsh Assembly

Government) seemed to underline the validity of current arrangements at the school

outlined during the interviews with the teachers. Once I had the necessary identification I was allowed to make my way to the mathematics department. On my first day, I was escorted by C1 who introduced me to teachers C3 and C4 at different times during the day, these were teachers who had not given interviews during the first phase of the research.

C1's classroom was situated at the top of a wide staircase, next to C4's office. The classroom was the first in the suite of mathematics rooms, which ran the length of a long corridor. At the end of the corridor was the smallest of the department's rooms with enough room to seat around 15 pupils. By contrast C1's classroom was large and well equipped with an electronic white board, computer and stereo system all of which were inter-linked. The walls of the classroom were adorned with some bilingual posters.

I observed a year 8 English medium group taught by C1 on my third day. C1 gave some details as to the abilities of the pupils as well as the arrangements for teaching year 8 pupils in general. Year 8 was organized according to a banded system. C1's large group, they totalled 28 in all, was a combination of set 1 and set 2 pupils. Many pupils, therefore, were of a high ability. At the time, C1 did not give any linguistic details relating to the pupils and I was left with the impression that the school was catering on the English medium side for pupils who were studying mathematics through their first language. During the follow up teacher interviews, C1 clarified the linguistic background slightly by explaining that a few pupils were "strong on Welsh" having been taught predominantly through the medium of Welsh to the end of primary school, but then had decided to change medium. C1 said that to his knowledge there were no other languages used by the pupils.

C1's first lesson involved pupils working through worksheets, which were C1's own work. C1 explained the department had been encouraged by senior management to develop their own material and that these were being trialled prior to distributing across the department. C1 spent the early part of the first lesson distributing worksheets and attending to other administrative duties. My records show that English was used on a consistent basis as the language of teaching and learning with pupils working as a general rule in pairs, discussing and answering the problems on the sheets.

C1 then began to work with the whole class on a sheet dealing with 'probability' at level 6 in the NC. The worksheet was based on the classification of different animals using a Venn diagram. The main focus of the lesson, without introducing mathematical terminology, was on discussion of the total probability of mutually exclusive events and subsequently how to calculate the probability of one event by knowing the probability of another event. This meant the pupils had to have an appreciation of fractions. The classroom interaction was of the IRE form, with the pupils, on the whole giving brief answers, although one able pupil, see the extract below, gave a longer explanation following some prompting by C1. I will go into greater detail in a moment when I look more intricately at the interactions.

Extract 1 Lesson 1

1   C1: OK one would be two fifths the other would be three fifth. I don't think you can

use the word opposite when you're talking about fractions. What's an opposite

fraction I don't know what that means really. Wha try and word it differently.

P: Em it's if you take the fraction you have and say it was a third to get the whole

5   number you add however many thirds you need to get the whole.

The teaching style of the second lesson differed from that in the first. On this occasion, the pupils were taken to the large computer room where there were enough computers for the pupils to work individually on the task. The task was derived from an American web site, and was introduced to the pupils as a piece of cross-curricular work involving music. Unfortunately, the pupils were unable to hear their compositions of minuets based on the activity of throwing a pair of dice, as the appropriate software was not available. In this lesson my personal microphone was set to conference mode, and C1 chose this location at different times during the lesson in order to listen to the pupil-pupil interactions as they cooperated in doing the task. Unfortunately, the quality of the recording was compromised. Interestingly, the small amount of pupil interaction that was audible seemed to reflect the banding system in the class. One pupil appeared to instruct

another pupil as to which answers to select to progress through the web site. However, the level of mathematical discussion designed to facilitate understanding appeared quite low. Indeed, the lower ability pupil expressed the sentiment that the work was difficult in the absence of scaffolding around the text and the mathematics it contained. I include the relevant section from lesson 2 below since it suggests that it might have been more appropriate for C1 to do the whole class lesson, which was eventually done as lesson 3 because of the software failure, prior to giving the children the individual task.

Extract 2 Lesson 2

1 P: What did you do here?

    P: I put down more than a hundred trillion and it says [inaudible]

    P: More than a hundred trillion.

    P: Click click on more than a hundred trillion and then the one [inaudible] next.

5 P: This is solid this is.

    P: Go to next there.

    P: What's the answer to

    P: Did you fill in that there?

    P: No you've got to [inaudible] here

10 P: What did you put there? What did you put there?

Given the disappointment of not hearing their compositions, C1 used the third lesson to work through the web site and work sheet as a whole class activity. The lesson included long turns by C1, which turned into brief IRE routines. It would not be entirely accurate, however, to state that all these routines were teacher led. The high ability of some of these pupils was revealed as some of the routines were inverted, with pupils asking a selection of closed questions, one of which caused some consternation.

Extract 3 Lesson 3

1 C1: That would be a thousand trillion. A hun a hundred trillion would be fourteen

        noughts one and fourteen noughts.

   P: C1 how big is a google?

C1:   A google is

5   P: A hundred noughts

C1:   Why do people bother asking me when they don't let me answer them. People

ask me a question and answer it for me. A google is ten to the power of a

hundred so in other words it's a one with a hundred noughts after it OK?

What became apparent in the third lesson was that the discussions that ensued from the questions initiated by pupils appeared to be advanced in mathematical terms, perhaps indicating once again that the banding system allowed a measure of dominance to persist, in this case the dominance of level six pupils over level five pupils. It may be that opportunities to alleviate such dominance, such as reorganising classes in streams for parts of the year, would have given level five pupils more opportunities to participate on the floor of the classroom. The banding in year 8 was eventually discussed in the follow up interview where C1 clarified, to some extent, the reasons for its implementation.

Observation of these lessons given by C1 in English confirmed my view that software for Welsh medium lessons was limited in scope. C1 would have to translate the hand-outs to extend the applicability of the lesson to other groups in the school, but the computer screens would continue to be in English as the sites used were from outside Wales.In fact, this would represent an area of commonality with existing Welsh medium and bilingual practice since teachers have long used English medium computer graphical packages and scaffolding in Welsh to underpin their teaching, lowering the level of differentiation between classes.

With regard to the language used in C1's class, the classroom interactions appeared to be almost entirely monolingual. One interaction, however, stood out. One word in Welsh was introduced by a pupil, leading to a fleeting departure from the language of the lesson. In extract 4 below, a pupil pronounced the Welsh for five "pump" incorrectly by saying [pʌmp] (as in shoe) instead of [pimp], the correct pronunciation in Welsh .

Extract 4 Lesson 3

1   P: What comes after a quad-trillion?

   C1:   I would be guessing it's all based on bi means two...tri means three... quad means four... so I'd be thinking what means five.

   P: P∧mp is five.

5 C1:   That's Welsh... we're talking what's got five sides? Pentagon or quad so I'd be thinking it might be something like pent pentillion.

By engaging in word play here and volunteering a Welsh word instead of a Latin origin word, the pupil may have been challenging the conventions of the symbolic order in this classroom (that is that English was the legitimate language for learning). It is difficult to interpret the incorrect pronunciation, the pupil may have been learning Welsh; but the teacher's abrupt dismissal of the contribution as 'that's Welsh' suggests he was reading it as a challenge. The dismissal also had the effect of representing Welsh as of less value than English or classical languages like Latin or Greek in the building of mathematical knowledge.

8.5.2 The lessons given by Teacher C2

Teacher C2 was a young teacher who was interested in translating English medium resources into Welsh, and then sharing them with other Welsh medium teachers. At one point, during the visits, C2 had a change of mind, and said that instead of being translated from published work, pupils' worksheets would be original material. C2's classroom was large and situated towards the far end of the mathematics corridor, and although there were posters of pupils' work on the back wall of the classroom, they did not appear to be recent additions. C2 had access to a laptop computer on the teacher's desk, which could have been a useful tool for contextualizing the mathematics for the pupils. As it was, C2 used a contextual explanation during individual tutoring on one occasion during the three lessons, whilst referring to a "lift". C2's other resource was a blackboard.

C2 explained the nature of the class I was to observe. The year 10 class was composed of eight Welsh language speakers, (C2 gave some more detail of the linguistic

background in the follow up interview). The group was the top set out of two Welsh medium groups. In terms of their mathematical ability, the pupils' SAT results the year before indicated this was a strong, relatively homogeneous group. Six of the pupils were at level 7 in their SATs and two were at level 6.

The class had received directed teaching during the week on the topic: 'expanding brackets', which is at level 8 of the National Curriculum. Once the class had worked through examples as a whole group, pupils were required to work as individuals or in pairs on the prepared worksheets. Intermittently, C2 would stop their work and check their answers. This lesson format, continued through all the lessons observed. During the lessons, C2 found time to explain the values underpinning language use in the classroom to me, and explained that one linguistic policy was to follow a Welsh term with an English term, and indeed this occurred for example in lesson 3 in relation to the introduction of quadratics although this term is identical. At a general level, as a series of lessons, the overall impression given was that they were focused on preparation for examinations. I now want to hone in on the many interrelated elements of classroom interaction that made up the series of lessons given by C2, as this might allow us to construct a more grounded impression.

Teacher C2's use of Welsh and English mathematical terminology varied. He revealed a slight tendency to use non-standardized mathematics terminology in spoken interactions with the pupils. These were deviations from the school's own mathematics terminology handbook which, on the whole, corresponded with the standard forms which are now common and accessible in the lists of terminology available across Wales, namely in the Termiadur (1998) and elsewhere. The interview with C2 had revealed some uncertainty over the use of two Welsh terms and this uncertainty was also observed in the classroom. Thus, for example, the extract below shows that the teacher could not remember the Welsh term for "coefficient", (cyfernod) and the pupils, therefore, were supplied with a non-standard description along with the standard English term.

Extract 5 Lesson 3

1 C2: Mae'r...be da ni'n galw'r rhif o flaen yr x... y [sca?] fatha tri x be da ni'n galw fo?

C2: Na dechrau efo c.

C2: Dwi'n meddwl ti di wneud dwi dwi'n cofio yn Saesneg *coefficient*

P3: Ti ddim yn cofio C2.

5 C2: Na *coefficient coefficient coefficient* yn Cymraeg cysonyn? Cysonyn ie na?

Coefficient dwi'n trio meddwl rwan.

P7: Just dweud mae'r rhif o flaen yr... achos da ni ddim yn gwybod.

C2: Na *anyway* mae'r eh rhif da ni gal... rhif adio iawn da ni'n galw fo... reit... yw'r
    rhif o flaen yr x OK

Translation

1 C2: The...what do we call the number before the x... the [sca?] like three x what do
       we call it?

   C2: No starts with c.

   C2: I think you've done I... I remember in English coefficient

5 P3: You don't remember C2

   C2: No coefficient coefficient coefficient in Welsh *cysonyn*? *Cysonyn* yes no?
       Coefficient I'm trying to think now.

   P7: Just say the number before the... because we don't know.

   C2: No anyway the eh... number we call... adding number right we call it... right... is
       the number in front of the x OK.

C2 also tended to rely on some familiar English terminology, with some terms, such as "equals" appearing frequently and in isolation in this Welsh medium class and subsequently being used by the pupils and shown in the next extract.

Extract 6 Lesson 2

C2:   Dau lluosi efo dau. So os oes genai c plus un di sgwario... be dwi'n

       wneud P1?

P1:   c plus un wedi sgwario *equals* c plus un

Translation:

C2:   Two multiplied by two...so if I have a plus one squared...what am I doing P1?

P1:   c plus one squared equals a plus one

C2's classroom language use, therefore, appeared to be variable and he was more comfortable in using English. However, C2 did seem to address the needs of second language learners of Welsh such as when introducing a Welsh acronym to the pupils in order to help them remember the routine for expanding brackets. This practice corresponded with C2's own stated policy.

The linguistic choices made during C2's lessons reduced the level of differentiation between the mathematical terminology used in Welsh medium classes and those in English medium classes, and encouraged pupils to go for terms which corresponded more closely. I list some examples below that give a flavour of the possible re-orientation occurring in the classroom. The first and third examples do correspond to standardized terms in both languages, but then, as can be quite well appreciated in these cases, the terms are virtually identical.

1)   Lesson 1 C2 uses Sgwario and *Squared*
2)   Lesson 1 pupil uses *cubed*
3)   Lesson 3 C2 uses pwer and *power*
4)   Lesson 1 C2 uses *equals*
5)   Lesson 1 C2 uses *'negatives'*

There were also instances where C2 used the correct standard Welsh term, such as in lesson 3. On one occasion in Lesson 2, a pupil used the term *plusio,* which is non standard, but C2 replied using the standard term, *adio*. C2 also adopted the Welsh standard term *hafal* [equals] in this lesson. Similarly, in lesson 2, C2 changed from the English to the Welsh standard term for 'measurements', namely *mesuriadau*.

What stands out from the six Welsh medium lessons observed in this school-those of C2 and C4-is the status given to Welsh numbering and its consistent use by the teachers and pupils in every lesson. Furthermore, these Welsh medium pupils were involved in sustained classroom activities, and this might have been the reason why I did not observe any level of dominance experienced by particular pupils. This may therefore

have contributed towards sustaining their interest in mathematics and may have been a contributing factor in their high level of attainment.

I want to give some brief consideration to the form of the IRE interactions during C2's lessons. This was of course a streamed class. The nature of the class probably meant that C2 did not need to enlist able pupils to construct mathematical meaning with less able pupils. As will become evident, teaching by C2 looked similar to the teaching style of C3.

8.5.3 The lessons given by Teacher C3

Teacher C3's classroom was large, and situated around half way along the mathematics corridor. C3 informed me that this Year 10 class, of around twenty three pupils was an accelerated intermediate class and that they were due to take their GCSE the following January, significantly ahead of schedule. Like C2, teacher C3 had access to a computer, which could have facilitated learning within different situations; the other obvious teaching resource was a white board. The walls of the classroom were adorned with some posters, and the assessment policy of the department, written bilingually, was displayed next to the white board.

The topic being taught during the week of my visit was 'standard form' at level 8 in attainment target 2 of the NC. In lesson 1, C3 reminded pupils of the rules for standard form by working systematically through examples written on the board. Subsequently questions were written on the board for pupils to practice and, after a further period of time, the answers were checked as a whole class exercise. The lesson resembled closely the IRE routines observable in other classes in both schools.

C3's approach in the second lesson was virtually identical to that in the first. After a series of examples had been worked through, six questions were written on the board and subsequently answers were checked after the pupils had been given time to solve them. The lesson then progressed, using a whole class method, to using a calculator to calculate the answers to standard form questions. Once again, this was done without setting a context to frame the learning perhaps reflecting the type of questions found on GCSE papers.

The third lesson I observed was rather different in nature, due to a timetable clash. Now the pupils were being prepared for a test, which was to happen the following week. The lesson involved working through a handout that included past GCSE questions. The pattern of teaching remained unchanged with the whole class being addressed followed by individual tutoring. At one point, towards the end of the lesson, C3 explained a problem to the whole class and was moved to comment that the same hands were being raised to answer questions put to the floor of the classroom, suggesting that some pupils dominated interactions. Having given a broad outline of the lessons given by C3, I now want to focus, as before, on the details of classroom interaction.

C3's lessons were notable for the encouragement given to some pupils during IRE interactions, even if they gave wrong answers, such as the one in the extract below from lesson 1. Pupil contributions were evaluated in ways that gave pupils a positive experience.

Extract 7 Lesson 1

P: I know.

C3:   You know?

P: Yeah

C3:   Go on then

P: Do you do seven times ten to the power nine?

C3:   No. But it's very sensible thing to think because we when we were doing this... multiplying two things with powers together... all we did was add... do some adding together but we didn't make it ten to the power nine or anything weird like that did we... so, I like your ten to the power nine I like that bit but I don't like your seven.

This kind of positive feedback was often given by the teacher. The teaching followed a three part sequence involving exposition of a mathematical topic by the teacher to the whole class, followed by individual or paired work by the pupils and culminating in a whole class review involving a discussion of the pupils' answers as recommended by the Qualification and Curriculum Authority. The interactions taking place within this

sequence were of the IRE type with many examples of the piecemeal construction of mathematical understanding. Although conversations such as these,were initiated by C3 to guide the learning, they were sometimes taken off in unexpected directions as pupils made initiations, like in other classes. This happened on numerous occasions, for example in lesson 3, shown below, where a pupil called out an alternative method.

Extract 8 Lesson 3

C3:   Yep divide by two hundred and fifty and again it's a non calculator thing you're expected to do it without a calculator. How many two hundred and fifties in five thousand P14? How many two hundred and fifties in each thousand? Yeah four in a thousand so twenty in five thousand.

P: C3 I...I did it like I doubled fifty and doubled two hundred and fifty

C3:   Yeah that's fine.

This democratic approach was complemented by pupils using C3 as an arbiter following their discussions, as in lesson 2 line 253 (see appendix 8). This point is related to the remarks made by Tanner & Jones (1991/2) who referred to the pivotal role played by the teacher in legitimizing answers.

Nevertheless, there were other events, which were unexpected and these centred on unidentified pupils who appeared to have had some Welsh language teaching at some point and pupil P6 who was in a "bridging" group. One unidentified pupil (C3 felt it more likely to be P2, but may have been P6) did not observe classroom linguistic conventions and replied in Welsh on two and possibly three occasions. The first occasion can be seen in the extract below taken from lesson 1. The answer "pump" [five], however, appeared to be overlooked with C3 choosing to work towards extracting the answer in the legitimate language of the classroom.

Extract 9 Lesson 1

C3:   Well I know I know where it's got to end up it's got to end up after the first digit like you've done it for... so how many hops does it take to get it there from where it starts

P: *Pump.*

C3:   One two three four five

P: Five.

C3:   So it's five hops

P: Ten to the power minus five**.**

C3:   Right that's the difference here when it's a tiny number like this you get a
        negative power of ten.

The following discussion relates to the second occasion where a pupil used a Welsh number as an answer. The interaction is a long extract (see Appendix 8b Lesson 2 lines 64 to 87), as it is possible to compare the different evaluations made by C3 to three responses given by different pupils.

C3's evaluation [Why?] of the response [*chwech]* – the Welsh word for 'six'- initially appears to be somewhat different from that given to another pupil in the previous extract; but, C3 accounted for this in an interview I conducted with him after I had completed the observations and given him a copy of the transcripts. He indicated that he tended to use the question "Why?" for several different reasons; which had nothing to do with the language used by the pupil. The use of the question "why?" seemed to occur in C3's lessons when a pupil had given an incorrect response. This is borne out in my data. In this episode the choice of language is overlooked and the focus remains on the exchange of ideas. The follow up response by the same pupil, which was in the official medium of the lesson was given a positive evaluation [right it's... yeah]. Indeed, the absence of an immediate positive evaluation to the Welsh word, which was a correct answer, may have been a reason for another pupil proposing a different answer.

The use of Welsh numbers by a pupil in each of the extracts discussed above (and shown in Appendix 8b) can be interpreted as challenges to the legitimate language of the classroom by pupils with a strong preference in Welsh. This tendency surfaces in another way in the following extract where the language being used is English but where the teacher switches from standard English into regional dialect forms of English. Here the teacher, C3, was reminded of the official language of the classroom by a pupil.

Extract 10 Lesson 2

C3:   Yes you could do it that way. I'd like you please to use your calculator... now are
         you listening P20 just a couple of minutes. I'd like you to just to use your
         calculator now to make sure that I've done... I've got all those right cos I did them
         all in *me ed.* [mi ed] (meaning 'my head' in standard English)

P: In your ed

C3:   Check please.

P: In your ed

C3:   Check your answers there... do each one of those calculations... you should be
         able to do that in two minutes.

As before, the teacher disregards the pupil challenge and carries on with the activity in
hand.

During C3's third lesson yet another pupil gave an answer in a language other
than the official language of the class. This is shown in the passage below. The pupil's
contribution is in Welsh.

Extract 11 Lesson 3

C3:   It is... you're supposed to times these two things I'm afraid. So you're going to
         get one mark there if you've added them... you will miss the second mark. OK.
         Again non calculator question... can we times these two things together hundred
         and twenty five times eight.

Ps: Thousand. Thousand.

C3:   Good.

P: *Mil*   [Thousand]

C3:   [Two of them would make two hundred and fifty wouldn't they... four of them
         would make five hundred eight of them would make a thousand.

P: Yeah *mil*   [Thousand]

C3:   [unclear] P8.

P8:   C3 I haven't done the same as you.

C3:   What have you done?

P8:   I've done five times twenty five

C3:   Right did you get a hundred and twenty five?

P8:   Yeah

C3:   Good

P8:   And then times two times two times two.

C3:   Good.

P8:   But I haven't done [Inaudible]

C3:   That's OK. Did you get a thousand? You'll get full marks. If you get the right answer you'll always going to get full marks essentially unless it specifically asks you for to show all of your working out and or something like that in between if it doesn't say that then whatever you do to get there if the answer's right you'll get the marks.

As before, the pupil's utterance in Welsh is brushed aside. In fact, C3's turn actually overlaps with the first use of the Welsh number 'mil' (thousand) so the pupil says it a second time. This is also disregarded. The teacher nominates another student instead. In C3's class, therefore, just as we saw A1's class, it is possible to observe a hierarchy of discourse practices, which might affect the participation of different members of the class. C3 clearly had a consistent strategy of non-reaction to the attempt by pupils to challenge the legitimate language of the classroom and by extension teacher authority.

8.5.4 The lessons given by Teacher C4

I had met teacher C4 about twelve years previously, whilst he was qualifying to be a teacher, indeed C4 had taken some of my classes at that time, many of which were mixed ability in their nature. Teacher C4 was by now an experienced teacher and had been promoted to the school's senior management team. I explained the nature of the research to him. I also noted the other school being observed was operating bilingual classes. In response C4 was moved to comment, "you'll never get that here". Right away, this gave me a sense of this teacher's commitment to the Welsh medium stream in School C.

The year 8 class I was to observe represented the entire year group of Welsh medium pupils in year 8. There were only 13 pupils. C4 taught this small mixed ability class at the far end of the mathematics corridor in a very small, cramped classroom which had a blackboard and a few posters, one of which looked as if it was about to fall off the wall. It appeared that no computer was available. C4 explained the linguistic background of the pupils in the class. Three of the pupils were from homes where both parents could speak Welsh, six pupils were from homes where one parent spoke Welsh and four pupils were from homes where the parents did not speak Welsh. Their mathematical ability was said to be in the range from level 4 to level 6, so there was no special needs support. There was no linguistic support for C4 either.

The resources for the lessons observed were quite basic, C4 was using exercises from the Heinemann mathematics scheme. He included some pedagogic strategy not seen in other lessons. These included asking pupils to participate in the lesson by calling them out to the front of the classroom. On one occasion, this involved two pupils drawing a diagram on the blackboard and on another occasion it involved asking pupils to gather around a pair of pupils to watch them completing a problem. My records show that the impression conveyed to me at the time of the lessons, was one of largely consistent patterns of language use by C4 and the pupils. The status given to the use Welsh numbering in the class may have contributed to this impression. As before, I will now take a close look at the recorded interactions to move beyond this first impression.

As I said, teacher C4 was an experienced teacher. What I did not point out was that his main subject was not mathematics and that as a member of the senior management team, his abilities were being used in other areas of the school. This lack of specialist knowledge in the subject became apparent quite early on by reading the transcript of lesson 1. Though, it has to be said, it was not as apparent during the normal flow of the lesson.

The first lesson began with revision of some work on fractions. The questions set were probably beyond level 4 pupils. C4 tended to ask open questions which resulted sometimes in pupils giving incorrect answers,

Following the exchange on fractions, the lesson changed direction and moved on to teaching the drawing of triangles at level 5 in attainment target 3 in the National

Curriculum. This required pupils to use an angle measurer and a compass. It should be noted that at GCSE, the WJEC (the Welsh examination body) has placed less emphasis on the latter method. C4 chose a participatory structure at this point, inviting pupils to draw a triangle on the board and asking, via an open question, what the difficulties involved were .This loosely defined talk, caused some consternation amongst the pupils and were summed up in one word by a pupil who said,"cymhleth" [complicated]. C4's open approach could have been an attempt to draw on the knowledge resources of the pupils to help in constructing the lesson, however, it did not provide many positive experiences for the pupils, for example a contribution from one of the pupils, a method of construction involving angles, which was accepted by C4 had to be rectified at a later stage.

Although C4's small class of around thirteen pupils included a significant percentage of second language learners, the resources available were Welsh medium and the language used including terminology was mostly Welsh, although there was occasional use of spoken English. This bias towards Welsh could be considered a factor in some of the problems experienced by pupils in the following extract from lesson 2. Communication problems, however, may also have arisen due to C4's hyper-questioning, or repeated questioning within a turn. In classroom-based research in another, quite different teaching and learning context, Roberts & Sarangi (2001) suggest that such questioning can lead to pupils withdrawing their participation. One pupil, P4, appeared to have some difficulty on two occasions. First, when a series of questions ending with an open question including the word "cyffredin" [common] was asked which elicited no response from P4.

Extract 12 Lesson 2

C4:   Oedden ni'n defnyddio cwmpawd. Ond pam o'n ni'n defnyddio cwmpawd yn

        hytrach nag onglydd? Beth da chi'n gallu dweud wrtha I am bob un o'r trionglau

        oedden ni'n defnyddio ddoe? P4. Be oedd yn wir be oedd gyffredin am bob un?

P4:   [Silent]

Translation

C4:   *We were using a compass. But why were we using a compass rather than a*

        protractor? What can you say to me about each of the triangles we were using

        yesterday? P4. What was true what was common about each one?

P4:   [Silent]

Secondly when an instruction including the word "cyffredinol" [general] was given by
C4.

Extract 13 Lesson 2

C4:   Gawn ni wneud o'n gyffredinol rwan dwi ddim eisiau gwneud o'n benodol ar

        gyfer hwn. Wneud o'n gyffredinol. P4 cam cyntaf.

P4:   Em mesur wneud llinell saith centimetr.

C4:   Dwi ddim eisiau gwneud o ar gyfer y triongl yma dwi eisiau trio wneud o ar gyfer

        trionglau yn gyffredinol. *So* bydd dull ddim just yn gweithio ar gyfer hwn bydd

        o'n gallu gweithio ar gyfer unrhyw triongl o gwbl.

P4:   Gwneud llinell syth [inaudible word]

C4:   Llunio llinell syth o hyd arbennig OK. Beth da ni'n wneud wedyn P9?

P9:   Em mesur pedwardeg ar y onglydd.

C4:   OK defnyddio onglydd mesur maint ongl.OK.

Translation

C4:   *Can we do it generally now I don't want to do it specifically for*

        this one. Do it generally. P4 first step.

P4:   *Em measure do a seven centimetre line.*

C4:   *I don't want to do it for this triangle I want to try and do it for*

        triangles in general. So the method won't just work for this it

        will work for any triangle.

P4:   *Make a straight line [inaudible word]*

C4:   *Draw a straight line of specific length OK. What do we do next P9?*

P9:   *Em measure forty on the protractor.*

C4:   *OK use a protractor measure size of angle. OK.*

Initially in the example above, P4 made an incorrect response to C4's use of the term 'cyffredinol (general), which required C4 to explain "cyffredinol" [general] more clearly. Despite this attempted clarification, pupil P9 continued to give specific values, which C4 decided not to correct. On this occasion, P4 and subsequently P9 may have been placed in less positive positions by the abstract, and therefore complicated nature of the questions and possibly because this Welsh word had not been defined beforehand. An alternative mathematical approach, however, could have been set for the pupils allowing them to move from the concrete to the abstract with the teacher eventually synthesizing the pupils' different answers. Although there may have been linguistic difficulties because words were not defined prior to use, the mathematical approach may have been fundamental in supporting understanding. The composition of this group of pupils was, of course, a complex one with diverse linguistic abilities and mathematical levels. Some schools, have included Welsh language support assistants in order to scaffold between the language of the teacher and the linguistic ability of the pupil. Of course, this does not necessarily help with mathematical issues.

In lesson 3, the evaluations made by C4 in the IRE routines changed in their nature This occured at an early stage. C4 began to use a more democratic approach asking other pupils to offer their evaluations by the frequent use of 'cytuno' [agree] or 'anghytuno' [disagree], as shown in the following extract.

Extract 14 Lesson 3

C4:   Pwy sy'n anghytuno efo hi? Pwy sydd ddim yn siwr? Pam bo chi'ch dwy yn

         anghytuno? Rhesymu... mae hi di dweu... ma'r rhesymu mae P10 wedi rhoi... mae

         hi'n dweud mae'r hyd yna yn chwech am y llysiau a mae'r lled yn ddau ar y tatws

         a gan bod y ddau yna yr un hyd a hwn... mae hi'n dweud bod hyd y lawnt yn

         wyth.

Ps: A beth sydd ar y gwaelod *though?*

C4:   Be sy... be di hwn ar draws fan hyn te wedyn?

P: Dyna be dwi eisiau.

P: Wyth.

C4:   Digon teg?

Translation

C4:   Who disagrees with her? Who isn't sure? Why do you two disagree? Reasoning...
        she has said... the reasoning P10 has given...she says that length is six for the
        vegetables and the width is two on the potatoes and because those two are the
        same length as this one...she says that the length of the lawn is eight.

Ps: And what is on the bottom though?

C4:   What is... what's this across here then?

P: That's what I want.

P: Eight.

C4:   Fair enough?

Further pedagogical problems arose on occasions. Pupils discussed their work with other pupils, as requested by C4, but they remained uncertain if their answers were correct and appeared not to know what to do.

Although, on the whole, compared with other lessons, the three lessons led by C4 were notable for the increased use of Welsh mathematical terminology by both pupils and the teacher, it could be argued that the Welsh terminology was familiar from primary school and that higher-level terminology was non-standard.

Where one pupil, P1, did use an English term, as in lesson 3, teacher C4 actually gave a positive evaluation, and then continued the explanation using the Welsh term "ongl" [angle]. This event seemed to differ from interactions in the English medium classes, where, on the rare occasions when it was heard, contributions from pupils in Welsh were mostly disregarded. However, I should note that the Welsh mathematical terminology introduced by C4 included a substantial amount of non-standard forms such as "Cwmpawd" instead of "Cwmpas" [Compass], and "fflat" as against "llorwedd" [horizontal] and although the word "gwirio" was used in lesson 2, line 45 (see Appendix

8), C4 showed a clear preference for the non-standard word "checkio", obviously equivalent to [check] which was used abundantly.

There appeared to be occasions in this year 8 class, just as in the Welsh medium year 10 class discussed earlier, where linguistic conventions were, at times, inverted by the students. Underneath the ebb and flow of the talk about mathematics there was a palpable 'undertone' of struggle among the pupils around the legitimate language of the class. For example, this was evident in the use of the term for 'centimetre' in the classes. The term for centimetre in Welsh, "centimetr" is almost identical to the English term, but is pronounced with an initial k velar stop [k] not a sibilant-[s] as in English. In the main, the pupils involved on the floor of the classroom used the Welsh pronunciation. However, one pupil (P10, in lesson 2, line 35: see Appendix 8) shifted the pronunciation from the English form to the Welsh form and therefore became aligned with the form used by the more vocal pupils in the class. Another pupil at the end of lesson 3, and shown below, chose the English pronunciation. C4 himself used both forms over the course of the three lessons.

Extract 15 Lesson 3

C4:   Pa graddfa da chi fod i wneud hwn ar?

        Which scale are you meant to do this on?

P: Un *centimetre* i un *metre*   [English pronunciation]

        One centimetre to one metre

C4:   Pa un rwan? O hwn sori ie dwi ddim di gorffen hwn naddo. Be mae hwn ar y

        ffordd i fyny?

        Which one now? Oh this one sorry yes I haven't finished this one have I. What is

        this on the way up?

P1:   Naw centimetr [Welsh pronunciation] Naw medr.

        Nine centimetre [Welsh pronunciation] *Nine metres.*

C4:   Pam?

Why?

Ps: Wyth a un.

        Eight and one.

P: Ond beth am gweddill yr un blodau *though.*

        But what about the remainder of the flowers one though

        The pupils most involved during lessons gave what appeared to be confident responses using Welsh terminology and these contributions were accepted in positive terms by C4, as can be seen from this example from lesson one.

Extract 16 Lesson 1

C4:   Pa enwau dwi'n rhoi iddyn nhw?
        What names do I give to them?

P: Rhif cymysg
        Mixed number

C4:   Perffaith rhif cymysg iawn? Peth cyntaf pan mae gennym ddau rhif cymysg beth sydd rhaid wneud? P1
        Perfect mixed number right? The first thing when we have two mixed numbers... what must be done?P1.

It should be noted that the pupils who commanded the floor most frequently in this class were higher ability Welsh first language pupils.

8.6   Themes from lessons observed in both schools

        Some common themes begin to emerge from this analysis of the lessons observed and the comments of teachers. Those themes include the following:

   1)   Variations in codeswitching particularly around mathematical terminology
   2)   Talk about linguistic values and talk generating linguistic values
   3)   Use of colloquial and dialectal resources as well as 'languages'
   4)   Different approaches to teaching

5) Near absence of mathematics set in real life situations to support children's learning

6) Similar patterns across all classes

On comparing the different types of classes, it seems that equivalence between the two languages has yet to be attained in any of the bilingual arrangements being tried. Although school C has achieved an increased level of Welsh language status, (this is evident from the consistent use of Welsh numbering), it is difficult to see how conditions such as less well-appointed accommodation, limitations placed on the teaching of the subject and on learning by some pupils, by virtue of the mixed ability nature of the classes, can be altered. There also appeared to be examples in both schools of policy slippage in the classroom, as terminology at KS3 and KS4 was not always applied consistently in school C and teachers' responses to the use of Welsh terminology could have been more positive in school A. Similarly it seemed that there were missed opportunities to be more accepting of Welsh terminology in the Eng lish medium classes at school C. Unlike the other classes observed, Welsh medium classes were characterised by fewer examples of undercurrents among pupils regarding the conventions of classroom language use.

Turning to the theme of linguistic values, although the teachers interviewed during this study expressed positive views about the use of the two languages in the mathematics domain, the classroom interactions recorded here revealed that Welsh and English were not always being given equal treatment.

The use of language in Welsh medium classes needs to be tailored for both fluent speakers of Welsh and good learners of Welsh. It was obvious that some everyday words required more explanation prior to their widespread use in the classroom. Some teachers used colloquial and dialectal resources in the classroom, which possibly brought them closer to many of the pupils. However, the teachers risked challenges to their authority in doing so. Where the language heard in the classroom veered from the legitimate and standard form of the language there were likely to be repercussions for the individual involved.

Reflecting on the different pedagogic practices observed, these were probably related to each school's ability to stream and the existence of different classroom

management styles. This study suggests that these practices are among the direct consequences of pressures experienced by Local Education Authorities, and then, in turn, the schools in their areas, as a result of changes in the sociolinguistic make-up of local school populations. Paradoxically, where the Welsh language has a low percentage presence in the community its value seems to be very high and the demands made on schools and LEAs to extend its use are accentuated (with schools adopting linguistic streaming and mixed ability classes). Where the Welsh language appears to have a significant presence, with a relatively high percentage of speakers, its value seems paradoxically low and the demands on schools and LEAs to extend its use are fewer in number (with schools retaining bilingual classes in Mathematics and other subjects).

The impact of these pressures on pedagogic styles, classroom interactions and language use was striking. Firstly, pedagogic style was similar across all schools. The pattern adopted was usually a three part sequence involving whole class exposition, individual or group work, followed by a summing up involving the whole class. Secondly, classroom interactions were overwhelmingly of the IRE type. The IRE routines observed gave the lessons a direction, which was lost, on occasion, when democratic approaches were adopted, as happened occasionally in the broad mixed ability class observed. These democratic approaches may also have been an indication of less certainty on the part of the teacher with regard to the subject. What was also apparent was that these IRE routines were sometimes inverted, perhaps creating a classroom environment that was only beneficial for some pupils. Some teaching styles, that were observed, were clearly of benefit to children because they reduced the level of domination by some pupils. Thirdly, language use in the Welsh medium classes reflected the greater space afforded to Welsh mathematical terminology, but the advantages of greater space was mostly applied to the vocabulary found in the lower levels of the mathematics curriculum.

The nature of pupil participation observed involved mostly higher ability pupils who even had the confidence on occasions to lead discussions along the lines of the familiar IRE routine. At other times, it seemed that the language chosen by the teachers could hinder pupils' participation and even silence some pupils.

My final point in this section relates to the one finding that was most surprising: this was the low level of contextual framing to support the development of mathematical understanding in many of the lessons. Mathematics was usually discussed in abstract terms with few references to real life situations or practical applications, although, on reflection, this aberration may have been due to a change of emphasis at GCSE level.

Taken as a whole, these interactions bring to mind Freebody's (2003) view, reproduced below, of the importance of communication in education.

> It is through communication that the social order in which educational activities take place is itself displayed, and thereby given structure and significance. The normatives of teaching and learning-what is normal, proper and appropriate in this educational setting, here and now-are made available to teachers and learners in talk, and in the varieties of other communicational forms they use. Students learn not only about curricular content, and not only about the communication patterns that characterize acceptable educational practice around that content, but also about the structure of society, the place and function of schooling, their place as students, and the nature, significance and consequences of their learning. They learn these things through their participation. That participation is both the means and the outcome of learning.
>
> Freebody, (2003:91)

These extracts of bilingual classroom discourses that I have considered in this study have demonstrated the complexity of the process of creating Welsh medium and bilingual spaces for the learning of mathematics. Although interestingly enough, there are suggestions (I.W.Williams, 2003) that the nature and significance of educational interactions such as the ones discussed above have been played down by those responsible for implementing bilingual and Welsh medium education in Wales, and explained away as primarily a matter of children from different educational backgrounds having difficulty fitting in. For this form of bilingual education to be sustainable, it seems that there needs to be greater awareness among educational practitioners generally of the ways in which classroom talk affects knowledge-building but also classroom relationships. There also needs to be a greater awareness of how the relative value of different languages is constructed through talk-not only in explicit comment on language but also in feedback to pupils and evaluations of their contributions to classroom conversations. If this greater awareness is not fostered stakeholders such as parents, might look elsewhere for their children's education. However, if bilingual schools choose

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to introduce a Welsh medium stream to offset these types of patterns, the opportunities of some pupils can be affected in other ways.

PART IV
DENOUEMENT

CHAPTER 9

CONCLUSION AND RECOMMENDATIONS

In this final section, I will begin by summarising the findings of this study. The summary will refer to the research questions that guided the overall study, which I will repeat here for convenience.

1) What has been the impact of the education reforms at the national and local level?
2) How have language policy developments at the national, regional and school level affected the use of Welsh in the teaching of mathematics?
3) What interactional practices emerge when different arrangements are made for the use of Welsh in the teaching of mathematics?
4) How similar are these interactional practices across the different types of classes?

9.1 Summary of findings from the school-based research

Although the degree of uniformity in terms of the curriculum taught and of the LEA language policies determining how children are distributed appears to have increased, differences do emerge from one secondary school to another in the classroom interactions that children experience. In some instances in the schools in this study, the nature of the interactions appear to be shaped by the school's ability to stream; both the banding and mixed ability classes observed seemed to allow some pupils better opportunities for participation.

Perhaps surprisingly, the mixed ability Welsh medium class taught by C4, which drew its pupils from diverse linguistic backgrounds, included little scaffolding and mathematical material aimed at pupils with different abilities. Where Welsh medium classes were observed that were similar to English medium classes in terms of streaming the patterns of interaction in mathematical terms were also similar. In Welsh medium classrooms, Welsh terminology, especially numbering, appeared to have higher status, which contrasted with bilingual classes where those participating on the floor of the classroom often chose English terminology.

In bilingual classrooms, four different pedagogic approaches seemed to be combined to manage the classes at various times. These approaches were English medium teaching, Welsh medium teaching, scaffolding in English and scaffolding in Welsh. The strategies differed from KS3 to KS4. In KS3 only two approaches were combined, Welsh medium teaching and scaffolding in Welsh. The teachers played a pivotal role in addressing the challenges of including the different linguistic resources of all children in the process of learning a common mathematical topic. At KS4, pupil cooperation and participation was less forthcoming when Welsh terminology was used. This posed some classroom management challenges to the teacher.

This research suggests that the dual literacy policy, advocated by Estyn, needs to be revisited. Rather than proposing an unproblematised "palette" of bilingual approaches for all Secondary schools in Wales where Welsh is used in the teaching and learning of mathematics, some account needs to be taken of the resources of local schools and practitioners, and School and LEA policies with regard to mixed ability teaching, banding or streaming.

Teacher style is also a significant factor. The teachers in this study gave different forms of encouragement. Contrary to my expectations, encouragement was given most often in teacher-dominated interactions and where teachers had a 'brisk' style.

9.2   Constraints on the research undertaken

There were a number of constraints on the research undertaken, but there are just three that I would like to foreground here. The first relates to my own development from being a mathematics teacher to being a researcher, from being partisan to being as disinterested as possible. This intellectual journey is best summed up as a gradual transition rather than an immediate change. I remain as concerned about the issues addressed here as I was at the outset, but as I reach the closing pages of this thesis, I realise that I have come to understand them in a different light, in greater depth and with all their complexity.

A second constraint that warrants a mention concerns the way in which I was perceived by the research participants, as a former mathematics teacher and as Welsh speaker who was local but also not local, an insider and yet an outsider. On the day I

arrived at School A, a female member of staff greeted me at the school gates and asked me whom I wanted to see. Following my reply, she said in Welsh: words to the effect, "You are not from round here." Clearly, my Welsh dialect identified me as not being local. How my dialect and my professional background impacted on the teachers' response to me and, in turn, on the results I cannot tell; but it may have had a bearing on them.

A third constraint that I need to mention relates to the scope of the study and its multi-level nature. Because it has involved discussion of educational reforms across the UK, their impact on language planning and policy at local authority level in Wales, on language policies in three local secondary schools and communicative and pedagogic practices in 6 classrooms, I have not been able to devote as much attention to detailed interactional analysis of bilingual teaching/learning events in classrooms as I had hoped to. Also, due to time constraints, I was not able to conduct interviews with students. This is certainly an avenue that needs to be pursued in future research.

9.3 Some directions for future research in Wales

One of the overriding concerns of the educational research community in Wales for many years has been the tendency for pupils at the transition point between primary school and secondary school to change the medium of instruction from Welsh to English. This tendency has existed among both first and second language learners of Welsh. However, what this research has brought to light is that the decision may carry with it consequences which might affect the learning of the pupils involved. Thus, for example, future research might be profitably directed at finding out how widespread is the tendency for teachers to ignore or redirect answers given by pupils not expressed in the legitimate language of the classroom. Or, alternatively, research of an action research nature (e.g. Carr and Kemmis, 1986) could be developed, in which a group of teachers work together to build an understanding of the specific ways in which they provide scaffolding for learners in Welsh and English, moving back and forth between languages.

Another way forward might be through continuous cycles of research along the lines of the 'ethnographic monitoring' proposed decades ago by Dell Hymes (1979). This would involve close study of classroom interactions, perhaps in collaboration

with reflective practitioners, with a specific focus on language use. Thus, for example, studies might focus on the use of different kinds of questions, or particular linguistic markers, or particular communication resources for expressing encouragement, or the use of standardized terms in both languages. The aim would be to identify ways in which both Welsh and English can be afforded equal status in the daily rounds of communicative life in classrooms, as well as in policy documents.

9.4 Recommendations for language policy and practice

There is clearly a need to extend the reach of awareness-raising regarding constructive bilingual practice to encompass teacher training for both Welsh medium and English medium classes. For example, teachers perhaps need to be made aware that some pupils may feel more comfortable using Welsh numbers and other terminology in secondary school lessons conducted through the medium of English. The goal would be to ensure that this can be dealt with in a more constructive way than that observed in the classes in this study so as to support pupils' participation.

A further way forward, at the language planning and policy level would be to enhance, or even take further, the degree of partnership between schools, so as to address the concerns of many stakeholders in the education system of Wales. These extended partnerships would involve neighbouring schools modifying their intakes to create a joint middle school and a joint upper school, and so allow issues of language status and subject needs to be tackled together.

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APPENDICES

Appendix 1   The distribution of Year 9 pupils between each Welsh medium stream in Area 1 LEA

Appendix 2   Welsh medium provision available at KS4 in each type of Secondary School supported by Area 1 LEA

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Appendix 4   Interview questions for schools A, B and C

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                 a)   School A: Teacher A1

                 b)   School B: Teachers B1 and B2

                 c)   School C: Teachers C1 and C2

Appendix 8   Sample of the following transcriptions of lessons

                 a)   School A: Teachers A1 and A2

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Appendix 9   Pro-forma for classroom observation

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Appendix 11   Questions for respondent validation

Appendix 12   Teachers' perspectives on the classroom data

Appendix 1

The distribution of year 9 pupils between each Welsh medium stream in Area 1 LEA

	60% through the medium of Welsh (*1st language and proficient learners)*	40% through the medium of Welsh (*Competent learners*)	20% through the medium of Welsh
School X	33%	22%	45%
School Y	44%	27%	29%
School Z	25%	40%	35%

(Italics = my clarification)   (Welsh Education Scheme, 2001.)

Appendix 2

Welsh medium provision available at KS4 in each type of Secondary School supported by

Area 1 LEA

	Designated Welsh	Traditional Welsh	English
KS4	90% ↑		
Welsh medium	60%	60%	
Provision *available*		40%	40%
		20%	20%

(Adapted from Welsh Education Scheme, 2001)

Appendix 3

a)

Allowances in Welsh medium education (2001)
Percentage distributed to schools according to Area 1 LEA's formula

26%   3%

34%

21%   16%

b)

Draft Allowances for Welsh medium education
Area 2 LEA 2000/2001. Percentages distributed to schools
according to the formula

3%   3%   3%   9%

9%

16%   19%

4%   12%

3%   19%

Appendix 4

Interview Questions

1   When was Welsh medium Education first introduced in your school?

Pryd cyflwynwyd addysg cyfrwng Cymraeg yn eich ysgol?

2   How is it currently organised at KS3 and then at KS4?

Beth yw'r drefn cyfredol yng CA3 ac yna CA4?

3   What are the main challenges you have experienced in organising Welsh medium education?

Beth yw'r herion pennaf â wynebwyd gennych wrth drefnu addysg cyfrwng Cymraeg?

4   When was Welsh medium mathematics introduced in the school?

Pryd cyflwynwyd mathemateg cyfrwng Cymraeg yn yr ysgol?

5   How was it introduced?

Sut cyflwynwyd ef?

6   How is it currently organised?

Beth yw'r drefn cyfredol?

7   Could you describe the nature of the KS3 and KS4 class(es) you teach? What is the average class size?

Â allwch chi ddisgrifio natur dosbarth(iadau) yng CA3 ac yna CA4? Beth yw cyfartaledd maint y dosbarthiadau?

8   What are the main challenges you have experienced in delivering Welsh medium mathematics?

Beth yw'r prif herion â wynebwyd gennych wrth ddarparu mathemateg cyfrwng Cymraeg?

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9   What steps have been taken by you or the department to address the needs of first language speakers and second language speakers of Welsh?

Pa gamau â weithredwyd gennych chi neu'r adran i ymateb i anghenion siaradwyr Cymraeg iaith gyntaf a siaradwyr ail iaith?

10   If your classes are divided along language lines what are the advantages/ disadvantages?

Os rhennir eich dosbarthiadau yn ôl iaith beth yw'r manteision/anfanteision?

11   Has there been any discussion in the department about the merits or de-merits of adopting bilingual approaches to teaching?

Â fu trafodaeth yn yr adran ynglyn â gwerth, neu fel arall, o fabwysiadu dulliau dwyieithog o ddysgu?

12   Any additional points you would like to raise?

Oes unrhyw sylwadau ychwanegol yr hoffech godi?

Appendix 5

Phase 1

Enw/Name	**David Hugh Jones**
Sefydliad/Institute	**Adran Addysg, Prifysgol Cymru Aberystwyth, Yr Hen Goleg.**
	Stryd y Brenin, Aberystwyth, SY23 2AX
E-bost/E-mail	_____

The aim of this Mphil/Phd project is to gain greater insight into how Welsh medium mathematics provision is taking shape across a number of Welsh rural secondary schools. I am particularly interested in the organisation of mathematics departments and how they are evolving to meet the linguistic needs of their pupils.

The project involves interviewing the head of the mathematics department and, where possible, a second member of the department teaching through the medium of Welsh at four secondary schools. Interviews will be recorded and then transcribed. Copies will be returned to the teachers involved. It is hoped that the interviews will be beneficial to the teachers involved by stimulating reflective thinking about current practice.

Nod y project ymchwil yw gwella dealltwriaeth o ddatblygiad darpariaeth mathemateg cyfrwng Cymraegmewn nifer o ysgolion uwchradd yng nghefn gwlad Cymru. Mae gennyf diddordeb arbennig mewn trefn adrannau mathemateg a sut mae nhw'n newid i gyfateb ag anghenion ieithyddol eu disgyblion.

Mae'r project yn cynnwys cyfweliadau gyda phennaeth yr adran mathemateg a, ble mae'n bosib, ail aelod o'r adran sydd yn dysgu trwy gyfrwng y Gymraeg mewn pedwar ysgol uwchradd. Bydd cyfweliadau yn cael eu recordio â'u trawsgrifio. Dychwelir copiau i'r athrawon unigol. Y gobaith yw y bydd y cyfweliadau yn gymorth i'r athrawon trwy symbylu myfyrdod ynghylch dulliau cyfredol.

Appendix 6

Phase 2

Enw/Name   **David Hugh Jones**

Sefydliad/Institute   **Adran Addysg, Prifysgol Cymru Aberystwyth, Yr Hen Goleg,**

Stryd y Brenin, Aberystwyth, SY23 2AX.

E-bost/E-mail _____   Phone _____

In the second phase of the project the intention is to look at the process of communicating mathematics in the classroom. In this phase I am interested in the role of language in building knowledge and improving understanding. In order to collect data of sufficient breadth for analysis, the project will look at classes in year 8 and in year 10 over a period of three lessons each. In each case, the first lesson will allow all concerned to become accustomed to the new situation whilst the next two lessons will be recorded. Transcriptions of the lessons will be returned to the department and the teachers involved for editing of any sensitive material. An analysis of the text by the teachers themselves would be most welcome and could be an opportunity for them to become more aware of the intricate interactions that sometimes occur in the classroom.

Yn ail ran y project y bwriad yw edrych ar y broses o gyfathrebu mathemateg yn y dosbarth. Mae gennyf ddiddordeb yn rôl iaith wrth adeiladu gwybodaeth a gwella dealltwriaeth. Er mwyn casglu data eang bydd angen arsylwi dosbarth ym mlwyddyn 8 a dosbarth ym mlwyddyn 10 dros gyfnod o dair gwers yr un. Ymhob achos, bydd y wers gyntaf yn gyfle i bawb ddod i arfer gyda'r sefyllfa newydd tra bydd y ddwy wers nesaf yn cael eu recordio. Bydd y trwasgrifiadau yn cael eu dychwelyd i'r adran ac i'r athrawon sydd yn cymryd rhan er mwyn iddynt eu golygu. Byddai hyn yn gyfle delfrydol i'r

athrawon ddadansoddi'r trawsgrifiadau a hefyd yn gyfle iddynt ddod yn fwy ymwybodol

o'r mân ddigwyddiadau yn y dosbarth.

Appendix 7a

School A Interview conducted immediately after the school day. Time 3.45pm Tape

machine- cassette recorder

Teacher A1 Translation

DHJ: I am interested in knowing how the organisation of the department has been

affected by the development of Welsh medium education.

General questions to begin.

When was Welsh medium education first introduced in the school?

A1: I'm not sure as to that date because I only started in the school this year

therefore as far as teaching mathematics through the medium of Welsh it started

about the early nineties to my understanding but it goes back quite a bit before

that as a Welsh medium school.

DHJ: **How is it currently organised at KS3 and then KS4 generally across the**

school?

A1: Em.

DHJ: Generally

A1: Well eh I'm not sure I understand the question correctly. We teach as regards

language you mean.

DHJ: Eh well with regard eh where eh Welsh medium education is ...... which subjects

is it taught?

A1: O right with regards the whole school?

DHJ: Yes.

A1: Yes em well everything is taught through the medium of Welsh except for

science and mathematics as I understand mathematics offers both

languages but if you eh......mixed classes teaching some that that do it through

the Welsh medium have notes in Welsh those that do it through the medium of

English have notes in English. Eh with regard science as I understand chemistry

do all of it through the medium of Welsh and physics and biology do all of it

through the medium of English I'm not aware of any subject that is done through

the medium of English.

DHJ: **What are the main challenges the school has experienced in organising Welsh medium education?**

A1: Eh well I believe persuading eh persuading parents more than anything of the value eh of learning mathematics through the medium of Welsh and em persuading them that it's possible and truly beneficial to the children eh to do it through the medium of Welsh.

DHJ: Eh *just* questions specifically about mathematical provision em.

When was Welsh medium mathematics introduced in the school?

A1: Eh the start of the nineties.

DHJ: **How was it introduced?**

A1: Well I believe as I was describing just say now some parents asking why they couldn't have it through the medium of Welsh

DHJ: Right

A1: and em that's the only reason and em and it was introduced as part of the teaching generally when it was available resources we use were all available through the medium of Welsh and English so the same resources available.

DHJ: Right

A1: and em the language of the classroom is Welsh on the whole anyway

DHJ: Yes

A1: has been always except that notes eh tend to give them in English and

exams are done through the medium of English.

DHJ: Right

Could you describe the nature of a class eh classes in key stage three and

then key stage four?

A1: It's similar in both the classes as I said are mixed eh some

that we we ask who [wants/demands] eh who wants it through the medium of

Welsh who wants it through the medium of English eh. Sometimes the Welsh

medium pupils sit together but not always em

tend to leave it to them. Em and then we we talk...

teach the subject eh mainly through Welsh we repeat each term anyway

in both languages and insist in key stage three that they copy every title

and each key term in both languages anyway whatever medium they are

doing it. And then the examinations are in the language they want. Work sheets eh

we prepare from new tend to be bilingual then they tend to

have a work sheet in Welsh and English.

DHJ: **Say in key stage four then do they is there a tendency for some to change**

over?

A1: No there is no tendency there is no tendency to change over the the the

system's the same but and people once they have started doing it through the

medium of Welsh tend to carry on eh to eh to the end.

There are some this year in year seven and eight who have changed from English

to Welsh and seen the eh eh eh the benefit in that because I had one girl on

Monday who said, "Oh I find it easier this year although I do it through English I

get more terms in Welsh find it easier then"

Ask then why she didn't do it through Welsh [laughter].

DHJ: So *just* to go over that in key stage three you have

mixed ability classes?

A1: The mixed ability is in year seven but they are setted in

year eight. They are mixed with regard to language because you know

you don't get a set don't get a set of Welsh Welsh set one and Welsh set two

there's not enough [inaudible]

DHJ: **So the next question is what are the main challenges faced by you?**

A1: Yes again em persuade parents I believe eh is the main is the main challenge eh

because eh strangely enough in this area Welsh can be heard on the street the

children in the school English is fairly weak very often they

think that it isn't the right thing to learn mathematics through the medium of

Welsh. I've come from an area [place name] where the the school was Welsh

medium and they didn't have a choice everyone did mathematics through the

medium of Welsh and no one found it difficult at all. One girl who did A level for

me through the medium of Welsh is at Oxford em you know and not having any

problems at all.

DHJ: **Em. What steps have been taken by you or the department to respond to the**

needs of Welsh first language speakers and second language speakers?

A1:   Well with regard Welsh first language speakers ensure that resources are

available if they want to do it through the medium of Welsh the

resources we use the same resources and they are available Vickers books for

example SMP books they are available in the same language so the same books

are used whatever the medium and talking. How do you define Welsh second

language speakers in this context because they come to this school as natural

Welsh speakers perhaps the language of the home is English but that doesn't

make any difference to them because they are fluent Welsh speakers or else they

wouldn't be here.

DHJ: m.

A1:   And so there isn't any need to make any alternative provision in fact except for

the fact that we give them the choice at the

moment.

DHJ: **So you wouldn't receive at the start of the year from the Welsh department**

any information about..

A1:   Oh there is information available and on the school's part a crash course is

run in year six and extends up to year seven for whose

Welsh is slightly weaker whether they come from an English background or not

that is have help with their language that does not

cut across mathematics

DHJ: OK. Thanks.

I think question seven is perhaps eh redundant.

If your classes are divided along linguistic lines what are the advantages or disadvantages?

A1:   Em yes well it isn't divided.

DHJ: Question eight em

A1:   Eleven here.

DHJ: **Has there been a discussion in the department regarding the value or else of adopting bilingual methods of teaching?**

A1:   Em we have had a small discussions as I said I've only been here a year

certain that they had discussions prior to that. I've given

my feelings very strongly and nobody disagrees with me.

DHJ: Did you have to give reasons?

A1:   None none in fact no you know I believe that we are reading from the

same book to tell the truth eh you know with regard to our aspirations and

feelings.

DHJ: Right. Is that to do with streaming?

A1:   No no not necessarily no we you know we ... The school has streamed

or setted em eh eh for some time and we

DHJ: Stream with regard subject I meant.

A1:   Oh no I don't stream with regard to language you mean?

DHJ: No is the way the em language in the classroom perhaps is an aid or not for the

subject.

A1:   In my opinion the Welsh language is a great help in regard to the subject because

of the terms the Welsh terms eh are more

meaningful on the whole than the than the English ones. As I said a girl this week

she says OK we get more terms in Welsh this year em rather than from books as

we did last year and using English books

and so she understands better. She understands the subject better.

DHJ: Last question.

Any additional points you would like to raise?

A1: No not really eh you know it's it's something that

people it's it's a pity people don't see its value There are some people

that feel very strongly oh no we can't teach maths through the Welsh medium and

I know differently because I've done both and em certainly I

think there are many many advantages than disadvantages.

DHJ: Right.

A1: Certain of that.

DHJ: Right, thank you very much.

School B Interviews conducted during free lesson 2.30pm onwards in the teaching rooms of the respective teachers. Tape machine-school's cassette used due to temporary fault.

Teacher B1   Translation

DHJ: I am interested in knowing how the organisation of the department has been affected by the development of Welsh medium education.

When was Welsh medium education first introduced in the school?

B1:   Three years ago for year seven only that period so.

DHJ: **What is the current organisation in key stage three ?**

B1:   It's in year seven they are only mixed ability and there are three classes well three classes of Welsh but one of them is for good learners so they get one hundred percent through the medium of Welsh or up to *sort* of *sixty seventy percent*.

DHJ: **Right is it available in key stage four.**

B1:   No not at all.

DHJ: It's not

DHJ: **What are the main challenges faced by you as a school in organising Welsh medium education?**

B1:   Well I believe [name] had talked with the office and they said we had to do more through the medium of Welsh. And in the first instance A she talked about just one or two modules but after that right do it all through the medium of Welsh.

DHJ: Right so all subjects are available?

B1:   No No they can do history, geography, French, DT em (inaudible).....music em

        They can't do em [repeat] German at all through the medium of Welsh

        [inaudible]they can choose if they

        want to do it.

DHJ: Right Right thank you.

        Em questions specifically about mathematics.

DHJ: **When was Welsh medium mathematics introduced in the school?**

B1:   Em thousand no two thousand and one

DHJ: **How was it introduced?**

B1:   Right we bought Allwedd mathematics books these for year seven but on
        comparing these with what is in the English they are too much writing on one
        page they are not *user friendly really*. So I began last year to try and do
        something different so I have prepared those so [name] translated them he
        translated everything I had in English.
        So we have those for two units in year seven so what I expect to do now

        is develop this for year seven next year to have seven units in all for year seven.

        I've done two I hope to do two others next year. So they are fairly useful I believe

        they work quite well and I teach the Bs, they're kind of good learners and when

        we go through we put the words down in English also so that they know what

        [inaudible] is but

        I believe that everyone thinks that they are OK so I hope that they are because I

        have spent hours doing them.

DHJ: **Em So to some extent the next question is what is the current organisation in**

        mathematics?

B1:   So well they start off doing eh number in the first term and what we

find is becasuse they are mixed ability there are some level two and some level five in the same so it's fairly hard really to just prepare things for all of them these are OK if we can use them they are OK for the top ones but for

the bottom ones we have to go to it to make things just that they can do so

we use these also so we must do thinking of doing unit five and unit

six next because there's unit four also so I have a lot of things to do.

DHJ: OK thank you.

Em can you describe the nature of classes in KS 3 and then KS4

B1:   So in key stage three they start off as mixed ability

and then in year seven in year eight sorry they go into

sets. So this year we have six sets in year eight but the thing is there we have Welsh first language speakers and then newcomers in the same class so it is just impossible teaching them bilingually we tried it [inaudible name] and it was just terrible it was just hopeless so we did nothing then we just stopped so [name] said right something must be done so this year what we thought we would do just swap them for a fortnight and teach then through the medium of Welsh so it worked OK but we had [name] off ill and [name] who taught maths moved over to science so we lost him also so one class in six lessons

had three different teachers so it was allright with my group and with [name] group but with the others poor things they had lost a lot so what we suggest doing next year is doing that perhaps once a term so that they get at least six weeks of teaching through the medium of Welsh

DHJ: So changing over.

B1:   Yes just yes because you must in maths I believe be in sets

because its awful trying to teach mixed ability really I'd like to see them in

sets in year seven but if we did that the Welsh language would

go then so [name] doesn't want to do that but em if we have a

fortnight each term that will be better than nothing really.

DHJ: OK so to some extent

B1:   And then in KS4 we don't do anything because em [name] thought that at the end

of the day they are going to do GCSE through the medium of English so better

that they don't do too much really of Welsh just that they

get a taster and no

DHJ: **OK So what are the main challenges faced by you in delivering Welsh**

medium mathematics? What was the main challenge?

B1:   So apart from just to develop the language really and use it in the class with the

Welsh speaking children in the class I speak Welsh with them but in the front I

speak English with the children most of the time but if someone has a problem we

discuss try to explain just so that they can understand what's going on.

DHJ: **What steps have been taken by you or the department to respond to the**

needs of Welsh first language speakers and second language speakers?

B1:   Em well if they are first language I speak Welsh with them *one to one*

[inaudible] and with English I speak [inaudible]

DHJ: **Next question if your classes are divided along language lines what are the**

advantages/ disadvantages?

B1:   Just on language so Welsh in one class and eh. In maths I believe that the spread is

        too much because we looked at one time at just dividing into

        sets to have Welsh sets one two three and English sets one two three and I compared

        the two sides and on the Welsh side there isn't much of a problem because we have a

        lot of clever children there because there are good learners in the Welsh classes

        anyway but on the English side in the [inaudible]when I did the sorting out in the

        English set one if I used chidren we had at the time then there were children from set

        one to set four in one class so because I had three tiers at GCSE and in the SATs that

        was we just couldn't raise standards with such complicated sets really so.

DHJ: **Has there been a discussion in the department regarding the value, or**

        otherwise, of adopting bilingual teaching strategies?

B1:   I don't

DHJ: [Repeats question]

B1:   Well

DHJ: You have answered that in a way OK

        Do you have any other additional comments?

B1:   No I think the only other thing we could do is do one small unit as we are doing in

        year eight and perhaps develop that for year nine and just have a fortnight or three

        weeks or just

DHJ: **Have you discussed with any other schools?**

B1:   No we haven't...I think that some... Which schools have

        you

DHJ: [Names of other schools in the project]

B1:   Right I don't think that they do a lot of Welsh maths through Welsh in [name of

         school] at all.

DHJ: Em A little

B1:   Yes not much I think last year more were doing maths through Welsh here than

         were in [name of school] so that was fairly interesting hearing that because well

         [inaudible]

         I think its worked OK but with the Bs after we did everything

         in Welsh up to Christmas and then I thought right so we are going to turn to

         English and I believe they find it easier in English because they are learners so

         and with these books sending them home to do homework because the parents

         couldn't read Welsh if they have a problem

         doing the homework because the excuses no we can't read the question [pronoun]

         I didn't know what to do so so that was a slight

         nuisance really that they

DHJ: Right thank you very much.

Teacher B2

DHJ: **I am interested in knowing how the organisation of the department has been affected by the development of Welsh medium education.**

DHJ: **General questions to start.**

When was Welsh medium education first introduced in the school?

B2: Well so far we have introduced it to year seven only and this is the second year I've been teaching the subject through the medium of Welsh.

DHJ: mathematics

B2: mathematics yes sorry.

DHJ: **What is the current organisation in Key Stage three?**

B2: Well at this point the organisation is that eh the children have according to their sets are setted well the children are taught by us in the classroom and so there are two Welsh classes one learner's class and eh an English class and there are two Welsh classes in year seven being taught through the medium of Welsh then when they go on to year eight because the whole year

is setted and we have a mixture of children of different languages we don't teach em a set of children through the medium of Welsh although I think the teachers have taught mathematics choosing one of the topics within mathematics just to tell you now and change the sets so that the Welsh are together for about a fortnight three weeks during the year.

DHJ: **What are the main challenges you have faced in introducing Welsh medium education?**

B2: Well uh because until two years ago because I had taught mathematics through the medium of English you know the terminology was the main challenge though

when I was a young boy speaking Welsh I had the terminology but you know

when you're talking twenty five years of not using terms trying to remember what

the terms are so that was the main thing but I have to say

by doing it this year the second year it has been much much easier

you know I've enjoyed teaching during the year.

DHJ: **Did you go on a course?**

B2: No no course at all no no courses.

[Inaudible]

The Welsh classes are fairly Welsh so it's more much more natural to speak

Welsh with them when I taught them through the medium of English I spoke

some Welsh with them of course the notes in

their books were in English.

DHJ: **Can you describe the nature of classes in KS3 and KS4?**

with regard the nature of the range of ability perhaps or

B2: Well yes in the stage we set children in year eight according to their ability only

and the same thing happens well they stay then most of the children

stay then in those unless they are wrong can't keep up with the work

or someone who is doing especially well move them up or move them down but

with regard language they are mixed but you know often the most Welsh pupils

are in the top sets because good learners are also clever children.

Children that speak Welsh are in the sets mostly there are more in the

top sets than the lower sets.

DHJ: **Is there a good learner stream in the school?**

B2:   Yes as I said they are divided in the first year according to language they are put into registration classes according to their ability in Welsh.

DHJ: Right

B2:   you know two Welsh classes and good Welsh learners the people

that can speak Welsh naturally and then there is a class of good learners people not quite as good in Welsh and then a class of people that can't spe....can't cope with Welsh

DHJ: **What steps have been taken by you or the department to respond to to the needs of Welsh first language speakers and second language speakers?**

B2:   I'm fortunate I've only taught the first language [name] been teaching the good learners so the only thing we had to get perhaps were books we got books eh Allwedd but unfortunately I think they are not suitable books for the Welsh the language is too difficult you know the language is difficult if it was in English anyway [inaudible] deficiencies are I feel there aren't any posters you know posters up int eh class that are in Welsh there are posters available in Welsh like those over there but they are just posters in a way for primary schools they are bilingual posters [refers to English poster on wall]

right you won't get that poster in Welsh because it'smore attractive to gain the attention of the children.

DHJ: **Has there been a discussion in the department regarding the value or otherwise of adopting bilingual teaching strategies?**

B2:   Well in the departmental meetings we do discuss teaching through the medium of

Welsh I believe the main reason we went into teaching mathematics through the

medium of Welsh was that the primary schools weren't teaching mathematics

through the medium of Welsh because we in this school wre teaching

mathematics through the medium of English so we were forced well we went into

teaching it in order that we rather than they could use the excuse of not teaching it

through the medium of Welsh

em on yes?

DHJ: **Regarding bilingual strategies have you come across any courses that discuss**

that or

B2:   Well with regard information I have read I haven't come across courses where

sometimes you have to teach mathematics through the medium of Welsh no one

during the last two years no one has been on a mathematics course through the

medium of Welsh. I don't know if they provide courses of that type or not

it might be a help but I don't know the important thing is that you are taught

mathematics I don't believe that the medium is very important

to an extent around here or certainly teaching mathematics through medium isn't

it improves the language of the pupils you know their language especially the

good learners [Inaudible but following passage to be heard] perhaps they can say

that is Welsh they tend to translate word for word at times

[inaudible].

DHJ: **Last question is are there any additional comments you would like to**

raise

B2:   As I said earlier I believe what I feel [repeat] there is that there is

enough resources to teach mathematics through the medium of Welsh you know

when I teach through the medium of English there are many

resources available take resources off the web there are programmes [inaudible] with lessons on them there are boo plenty of choice of books unfortunately in the Welsh language we are constrained as to the amount of choice we have and so you know to interest the children in the subject it's much more constrained isn't it.

DHJ: Right thank you very much.

School C   Head of Department Interview-time 11.30am during free lesson before lunch.

Tape machine- Sanyo Talkbook

Teacher C1

DHJ   I am interested in knowing how the organisation of the department has been affected by the development of Welsh medium education. So general questions to begin with about the school.

When was Welsh medium education first introduced in the school?

C1   Em as far as I know its been going quite a long time Em I mean I couldn't actually answer that question. This has been a designated bilingual school for well before since I've arrived at the school.

DHJ   **When did you arrive?**

C1   I arrived in 95 that's 9 years em but I know members of staff who were pupils here themselves and they have been educated bilingually or in Welsh so I think it's going back a considerable amount of time.

DHJ   **How is it currently organised at KS3 and then at KS4 generally across the school?**

C1   Em We have six or seven form entry it varies em from year to year normally six form entry but we did have a seven form entry a year or two ago and we've got another one in September and one of those forms will be a Welsh medium group its designated the C group

DHJ   Right

C1   Em there is also the bridging group called the W group which consists of strong Welsh speakers but not first language speakers. The C group is predominantly those that whose first language is Welsh they speak it at home em predominantly

and have been to Welsh medium primary schools in the area. The W group may

be pupils who em maybe their first language isn't Welsh but they perhaps still

been to a Welsh medium primary school so they are fairly fluent in the language.

DHJ **Is that a large group?**

C1 Its about it varies the C group for example the current C group in year 7 is only

twelve pupils where as a year or two ago it was twenty eight.

DHJ I see

C1 It varies quite largely depending on the strength of the Welsh language of the

pupils coming in but usually its in the low twenties is the normal size. The W

group tends to be in the twenties its never fallen very low em but it tends to be in

the mid twenties usually. The other five or six forms four or five forms are just

English medium. So the Welsh group will have all their lessons through the

medium of Welsh where possible I mean there are some departments some small

departments where there aren't actually any Welsh speaking teachers therefore

obviously they still deliver in English em but where possible the C group have all

Welsh speaking teachers they do all their written work speaking work in Welsh.

The W group em they try to give them as much as possible Welsh medium

teachers em some of the conversation in the class would be perhaps in Welsh but

the written work would all be in English

DHJ **So third**. **What are the main challenges the school has experienced in**

organising Welsh medium education?

C1 Partly getting Welsh medium teachers I know the maths department for example

we had a Welsh speaking teacher leave a few years ago and we really did struggle

to replace them because there just weren't any qualified maths teachers that could speak Welsh coming through and that's been true in other departments as well em there is a lack of resources text books and other materials in the Welsh language I think those are possibly the two major problems that the school faces in delivering Welsh medium.

DHJ   Right questions on mathematics specifically

When was Welsh medium mathematics introduced in the school?

C1   Well probably again I mean its well before my time one of my colleagues in the maths department was a pupil here he was educated in Welsh so I would imagine it goes back probably as far as the school has been operating a Welsh medium group

DHJ   **How was it introduced?**

C1   I couldn't really answer that off the top of my head sorry.

DHJ   Fine

How is it currently organised?

C1   Well I've already explained in year seven there is the Welsh form and they are all taught in their tutor groups in year 7 for all subjects mixed ability tutor groups so the C group would have a Welsh medium teacher and they would follow a course through the medium of Welsh. The W group would just be taught the same as the English group. And then in year 8 we set them across the year group predominantly but the Welsh C group is kept separate from the English groups in the [inaudible] we normally are able to set them into two groups so we take the one tutor group and make them into two maths sets unless the tutor group is very small for example in this year where there is only twelve when they go into year 8

they won't go into two groups they will stay as one group but normally if the number is up in the twenties then we would have set one and set two on the Welsh side and that system continues right the way through key stage three and key stage four up to GCSE.

DHJ **Could you describe the nature of KS3 and then KS4 classes that you teach? The English groups that is**

C1 Nature in terms of their ability

DHJ Yes their ability

C1 We have a wide range of ability of pupil in this school em you know right the way through from the very able to pupils with special educational needs and statemented pupils. I teach a variety of sets in different years of different ability em and A level work as well you know em

DHJ **Is the ability spread out or do you find you keep them close together?**

C1 We tend to have a policy of whole class teaching in the department we tend not to we don't follow any individualized schemes or anything like that so we as I said we set from the beginning of year 8 into em usually into six maths sets on the English side and those would be finely fairly finely em streamed on ability and we tend to take those classes forward as a group em obviously you know they are not all of equal ability and we move people up and down during the course of the year occasionally if they are finding work too difficult or too easy.

DHJ OK

What are the main challenges the department has experienced in delivering Welsh medium mathematics.

C1   Yes well there has been a problem in the past of getting qualified staff but at the

        moment we are very fortunate in that we've got three Welsh speaking maths

        department members in the maths department out of seven of us there are three

        that are fluent in Welsh and been educated in Welsh completely through the

        medium of Welsh.

DHJ   **How many of those are full time?**

C1   They are all full time em although one of them is one of them is a member of the

        senior management team so his timetable is fairly light I think he only teaches two

        or three maths groups like. The other two are full time maths teachers and do very

        little else a bit of IT or something like that virtually completely maths and then

        there are four of us that are just English medium.

        So in the past there have been problems with recruitment and eh but at the

        moment the situation is quite good from that point of view and even if one of

        these left we would still be reasonably well covered on the Welsh medium side of

        things. Em the major problem that we are encountering at the moment is the lack

        of resources em we have just adopted a new key stage three scheme for the

        English groups em a scheme that ties in with the National Numeracy Framework

        but its just not available in Welsh and there is nothing really bang up to date

        available in the Welsh language at the moment so they are still using a scheme

        that is about ten years old now with the Welsh classes.

DHJ   **What's the name of the English scheme that you are using?**

C1   Its called Maths Frameworking published by Collins. I've enquired as to whether

        they have any plans to translate in the future but they couldn't give me a definite

        answer on that only if the demand is there they said so they are using with the

Welsh groups we're using an old scheme published by Heinemann which has been available in Welsh from from almost the beginning and we've used in this school now as I said for eight or nine years.

DHJ   OK

What steps have been taken by you or the department to address the needs of Welsh first language speakers and second language speakers of Welsh.

C1   With regard first language speakers you know we try to ensure that they have do have materials available in the in the Welsh language as far as we are able to and obviously are taught by a fully fluent Welsh speaker and we've been able to do that to an extent the material there are more materials available at key stage four than at key stage three we're better off at key stage four at the moment than we are at key stage three in terms of resources but they still em are not as good as the English medium resources especially when you come on to computer software and things like that I mean you just can't get it.

Em sorry I've forgotten the second part of that question.

DHJ   **How do you address the second language?**

C1   Oh the second language em the second language the W group for example is we try and make sure the teacher as far as possible is at least partly able to speak Welsh you know some members of the department are not first language or fluent but are [inaudible] or have got some Welsh background are able to hold simple conversations perhaps in Welsh on a day to day basis but not actually to deliver the subject in Welsh.

DHJ **Do you have in the Welsh medium stream have you any second language learners if you see what I mean?**

C1   There will be a few pupils in there that em maybe the parents do not speak Welsh at home. We have had requests sometimes to provide them with English copies of the text book for example if they are following the Welsh version then sometimes the parents are not able to help them with homework we have had one or two requests if we could send home an English copy of book so they can use side by side. When it comes to the exams as well some of the pupils like to have an English copy of the exam beside them just for reference even though they are writing on the Welsh version they may have at key stage three it's pretty normal for them all to be given a Welsh eh English version of the exam paper as well occasionally there are terms technical terms they may not be familiar with technical terms and things like that.

DHJ   Right OK.

       If your classes are divided along language lines which they are what are the advantages or disadvantages?

C1   Well obviously the advantages are that those that prefer to be educated in Welsh obviously that's able to happen they are able to have a fully Welsh curriculum delivered to them em I suppose the disadvantages are that there does seem to be a bit of a them and us em attitude a bit I think the Welsh medium pupils tend to be em sometimes a little resentful perhaps of the English speaking perhaps they feel a bit in a minority and there has in the past been a little bit of sort of [inaudible] between the two groups this is just not on a mathematical basis this is perhaps

generally speaking throughout the school em the Welsh predominantly the Welsh speakers tend to come from perhaps different parts of the locality or different types of em environments perhaps than the English speaking pupils and they [inaudible] which has occasionally caused problems.

DHJ **Last question but one have you noticed any patterns occurring within the department so say staffing, results, pupil movement?**

C1 Em we found eh certainly when I first started here the Welsh medium results say at key stage three and key stage four didn't appear to be as good as the English and there did tend to be a definite eh lower standard reached by the pupils on the whole I mean the difficulty there obviously in that your sample size is a lot smaller and that one or two pupils performing badly in a class of twenty can obviously have a bigger effect on the results than on the English side em but there was definitely in the first say five or six years that I was here it did seem the Welsh medium groups were struggling a bit to keep up with the English groups. However in the last few years that situation seems to have evened out and in fact on a couple of occasions the Welsh class have actually performed better than the English I mean for example in our SAT results that we got through last week em everyone but one in the Welsh medium group got a level five or better. Em which was in terms of percentage a higher percentage than on the English side so that does seem to have been addressed and there does seem to be parity between the groups em from a results point of view.

DHJ   **Em any additional points you would like to raise?**

C1   Em No I don't think so our biggest my biggest eh concern I think is that the

Welsh groups often seem to get almost forgotten on a day to day basis because

because they are in a minority and because [inaudible] separate from the English

groups there is a tendency as far as I am concerned when I'm thinking about a

year group I tend to be thinking of the English pupils in that year group more than

the Welsh because they're almost like a separate entity and because of my lack of

ability to speak Welsh I'm not able to perhaps to be involved in there as much as

perhaps I would like to or should do em so in my own mind I tend to segregate

them a bit and think of them as separate separate entity when perhaps we should

think of them as being more integrated.

Whereas often of course because of they might be using different resources they

have their lessons obviously at different times when you know everybody in year

nine might be having maths on the English side it will be different on the Welsh

side and so you tend to again think of them as being separate entities from that

point of view that's my main feeling

DHJ   Right thanks very much.

C1   Thank you.

School C Interview conducted in teachers' classroom at 11.50am during a free lesson

before lunch. Tape machine-Sanyo Talkbook

Teacher C2   Translation

DHJ: **I would like to know how the organisation of the department has been**

        affected by the development of Welsh medium education.

        General questions

        When was Welsh medium education introduced in your school?

C2:   Well I have been here two years so its been here before that so [   ]exact time but

        its been at least twenty years something

        like that.

DHJ: **What is the current organisation in KS3 and then KS4 across the school?**

C2:   Across the school?

DHJ: Yes

C2:   Oh right eh what books and so on or

DHJ: The groups

C2:   One Welsh group and six English [inaudible] the Welsh [portion?] really is quite

        low. The Welsh group is divided in two so there are six sets

        in English eh and eh that occurs at the end they are setted at

        the end of year seven then eight nine ten eleven all in their sets.

DHJ: In most of the subjects?

C2:   Yes in most yes some [inaudible] set specifically in some subjects

        They are just they are divided into the best thirty throughout the year

        in different subjects but in maths we keep them you know as standard really.

DHJ: **What are the main challenges the school has experienced in organising Welsh**

        medium education?

C2:   Resources as simple as that em the school has a fairly good bilingual policy and

        so the Welsh have the same privileges so to speak as the English if anything they

        are better because if there is you know one group there would be one

        Welsh group but it gets setted inside with fewer pupils in a class for

        example top set year ten is nine and the second set is nine. In year

        eleven we have a top set of sixteen and a bottom set of six so then it

        benefits but then the resources are difficult we are working on

        them at this time.

DHJ: Em questions about mathematical provision.

DHJ: **When was Welsh medium mathematics introduced in the school?**

C2:   I think the same time as Welsh education to tell the truth.

 DHJ: Right

DHJ: **How was it introduced?**

C2:   Em in em in key stage three we have Heinemann books those books Heinemann

        and those are fairly good [inaudible] since ninety something

        I think ninety three they were first introduced em ninety five

        [inaudible ninety five] they are quite good [inaudible] started they are

        dated now but except for SMP and those I don't think there is anything else

        available em which is a problem to be honest because with the English ones I

        don't have a copy we have got new books now because the English did follow

        the Heinemann and then but better books are available in English Collins

but those perhaps those will be translated so we are still working on Heinemann

at this point. Key Stage four [inaudible].

DHJ: How was it introduced?

C2:   KS4 Em We didn't have any resources we were using a lot of English books that

we have and using examples because in mathematics at

the end of the day x plus three is the same in language so instead of perhaps using

books that are sort of not as good just for the sake of Welsh

it was better to use English books but to present it in Welsh and then

use English examples because that was the best option. But what I am

doing now very *foolishly* I am actually translating that book with

Welsh examples I have started doing it now so then we will have

something similar we choose the best of that with the other books so we will have

in KS4 at least we will have a GCSE book for every set really and it will

work because I don't think there is one that is good enough in Welsh.

DHJ: Right OK

Em Can you describe the nature of classes in KS3 and then KS4?

C2:   Welsh?

DHJ: Yes

C2:   [Inaudible]Just ability or

DHJ: Generally

C2:   Em as I was saying small sets really [inaudible] classes it's

fantastic to teach because you know it's a lot easier to discipline instead

[inaudible] it you are teaching one of the lower sets in English you have twenty

pupils and perhaps there will be a high percentage of them not behaving very well

Well in the Welsh you only have nine and those those nine are from sets

four five six so to speak only three will be and it's a lot easier keeping

order over three pupils than it is over fifteen em a problem perhaps with sets

[green?] is language because we have dividing into broad sets the language of

some is better than the rest that is difficulty but sort of work that as

time passes they get used to the mathematical

language

DHJ: Do you receive any information about their language levels?

C2:   Yes we do through SATs in year seven usually at least one teacher well we

have three Welsh teachers but we did have in Welsh mathematics now

but we did have just two of us and what would happen we would

divide sets one taking set one one year and the other taking another set so that we

kept continuity where one teacher taught year seven carry

on with some but the other so as far as language comes into it we

teach them for such a long period we just become used to their linguistic strengths

we look at them and we know who is weak in languages.

DHJ: How do you respond to that then?

C2:   We just take our time with them really em what I tend to do

is write on the black board with set two more than set one that is give translations

and use words that are simpler really [my Welsh isn't as good as that anyway]

but for example em if I used appropriate Welsh like with

fractions for example I would say numerator denominator with the top set but

with the bottom set I would say bottom number and top number then put in

brackets numerator denominator and so on just so that they would learn it like that

because rarely will a question ask for the denominator or its a lot easier to teach

for example if I want to find this fraction just say divide bottom number multiply

by the top number pupils understand it a lot better than having to go through the

language that's how I anyway [inaudible].

DHJ: Right Ok thanks

DHJ: **What are the main challenges faced by you in delivering Welsh medium**

        mathematics?

C2:   Em what in actually teaching?

DHJ: Yes teaching

C2:   Going back to the resources to be honest I have been working now only for a

fortnight I have been working on my new system and I'm finding it

much easier because I don't have to search for anything and also I know

you know language the language of examinations especially is difficult they are

they are translated well it's obvious that they are translated

you just get big Welsh words that children don't understand I feel

sometimes that it creates creates lots of problems because I've had children

coming to me with in the mocks with twenty per cent in exams and then

I have sat down with them and say well that question you do this and then

why and the answer is why don't they just say that instead of using the language

that OK correct language not arguing with correct language but it's language that

children do not understand because they are quite advanced as you know if you

get set two where the language skills are very low they find it troublesome to

answer questions. That is one of the main things you know. In with this school

I think and I have taught myself in [place name] also [place name] is

too much English it's fairly difficult also to try to get children to talk

Welsh in mathematics.

DHJ: Right

C2:   because often I would hear Oh what do we do now? Well what you've got to do

you've got to take that to then *differentiate* it in it.

so using Welsh and English language

DHJ: together

C2:   and that and that can be difficult for them too

DHJ: **In a way you have answered the next question but I will read it but What steps have been taken by you or the department to respond to the linguistic needs of Welsh first language speakers and second language speakers?**

C2:   Em what I'm what I'm trying to do with children I hear them speaking English

I immediately [inaudible] come on Welsh please and they will just

keep on with that because I think that it's it's oh what's the word

affecting their work if they speak English read talk used to

Welsh so to speak and then they they get an English copy but an English copy

doesn't help because they haven't learnt the work in English.

Some sort of Wenglish [inaudible word].

DHJ: **If your classes are divided along language lines what are the advantages or disadvantages?**

C2:   Advantages are the size of groups I've said so that it is one to one pupilage is far higher perhaps for example in the top set year ten again I have nine well it's a lot easier to teach I can just put what I want on the white board and then if children have problems with it it's a lot easier for me with nine pupils so as lessons are made I can give [inaudible] on the white board for those that are more able so more able just carry on as they want and then those that are having trouble spend five minutes with one and still have ten minutes at the end of the lesson. When it comes to English classes I have thirty in the top set in year ten then I have to make sure that everybody understands so those are the advantages with teaching in Welsh that has nothing to do with the size of Welsh in the school rather than the language language can help [inaudible] language helps with *similar congruent* triangles in English its similar but in the Welsh we have two languages so that helps.

Disadvantages oh that's more again with size the fact that in set one in the Welsh we have set one two three in English three four five and four five six in English so that doesn't help because it is there are ability there's more ability then you have to set so you have to do work in the middle not perhaps beneficial to some pupils size really with language I don't see.

DHJ: Do you have to teach a Welsh medium group in front without an individualised

scheme or

C2:   What do you mean?

DHJ: That is although you have a broad class do you target?

C2:   Target. What I do is I I don't well I don't target below what

I target for with the top set is whatever is they do the top paper and the same

with set two they are better in top really and it's a lot easier for example I

teach them to a paper one paper higher for example and just say well no do

one lower it's easier for them just say then well I don't have to lear it's

not as bad having to do it because and also I think it is a help to

children because children have to do something far more difficult than they

are able when they come back to do work that's easier perhaps they don't

understand it better but they feel it's easier and they have more confidence

because they have it was a lot easier than what I'm doing so.

DHJ: Right OK

DHJ: **Last question now are there any additional comments you would like to**
raise?

C2:   No I don't think so I've said everything I want to really. As I said my main

criticism regarding it is that the resources are not available that's why

I hope that this will help once it will take two years to choose to take to do but

once it is in place I'm quite happy to give it to Welsh schools because the problem

is we have books by WJEC WJEC CBAC like these a few years ago but the

problem is they are

based on the children knowing the whole course.

DHJ: Right

C2:   and there are a lot of examination papers examination questions in these and what

        happens is that they need to know so if I [need] to start GCSE and I sort of need

        to do a question I've got to teach something and something else and then it isn't it

        isn't easy to teach using these the only books are the SMP books

        once again SMP has problems because they jump too much from place to place

        and also there are different books. And Vickers they've made Welsh books

        but the problem with Vickers is also [inaudible] books six seven eight nine and A

        star and the problem is if its fifteen pounds a book well to teach one pupil

        in a class you are talking sixty pounds and that isn't no one can

        afford that's what I'm hoping with these if I can

        I wouldn't have a problem saying [inaudible in school?] *oh come and see*

        me and then they would be able to just print them and place them in their own

        files that is I believe the way forward because those they are

        fantastic to revise at the end of the course but not to teach the course [inaudible]

DHJ: OK fine thank you very much.

Gwers 3 Athro A1 Blwyddyn 8 Set 2 Amser 11.05pm [Heb ficroffon personol]

Lesson 3 Teacher A1 Year 8 Set 2 Time 11.05pm [Without a personal microphone]

Cofrestr/*Register*

A1:   Reit rwan te chi'n cofio P1.

P1:   Ie

A1:   Gwrando OK bant a ni te. Faint yw *minus* pedwar *plus* chwech b *minus* tri a *minus*

         saith b.

P: Oh na.

A1:   Ah.

P: Pryd pryd oedd?

A1:   Pryd oedd hyn nawr?

P: Na pryd oedd y pryd wnaethoch?

A1:   O ni di bod yn wneud hyn ers tro nawr sawl gwers P ers pryd ti di bod ma?

P: Em.

P: A1.

A1:   Good falch gweld dwylo lan. Gewch chi'ch cyfle nawr mewn munud. P1

         [inaudible] lais yn siarad dyma cyfle nawr i ateb.

P1:   *Minus four as thirteen.*

A1:   Em P21

P21:   *Minus seven a em a minus one b.*

A1:   Da iawn reit P1 co wi di cael hwn wedi rhoi lan ar eich cyfer chi wi am gael un

         arall ar yr ochr arall rhyw ddiwrnod jest er mwyn chi mae hwn OK ond bydd pobl

         erill yn elwa hefyd.

P: A1 pwy ddaru wneud e?

A1:   Fi.

P: Oh. Mae eisiau i chi mae cwestiwn o'n i'n meddwl mesur e mas [inaudible].

A1:   Pam hynny?

P: Mae e tair ar ddeg i'r top a un deg chwech yn groes.

A1:   Ydy mae'r papur oedd da fi yn wahanol seis dyna pam. Alreit sylwes ti'n dda

        chwarae teg ond benderfynais i o'n i ddim am fynd lawr gymaint ag o'n i mynd

        lan. P4 be oeddet ti eisiau gweud bach?

P4:   Oh [inaudible].

A1:   Oeddet ti'n cytuno â'r peth na?

A1:   Mm? Oh plis na.

P4:   Na.

A1:   Eh beth sy'n bod ag e?

P4:   Em *minus minus one.*

A1:   Wel *minus* pedwar yn dyfe lawr *minus* pedwar a ti'n tynnu ffwrdd tri oddi wrtho

        fe yn dyfe so ti'n mynd lawr. Dechre chwech lan fana chwech fana a ti'n mynd

        lawr saith ie siwr nawr hapus OK P11?

P11:   Yfe saith a *plus* un b yw e achos mae dau *minus* yn ateb?

A1:   Na na adio a tynnu yw rhein mynd lan a lawr y llinell wyt ti'n wneud dim lluosi

        pan ti'n lluosi ti'n cael dau *minus* yn wneud *plus* cofia na reit mae'n bwysig.

P: Ydy saith a yn anghywir achos mae eh *minus* pedwar a a *minus* tri a yn wneud

        plus.

A1:   Nady dyna beth o'n i'n weud nawr pan ti'n adio tynnu yw hynni reit eh ti'n lluosi

        yw hynni pan ti'n adio a tynnu ti'n jest yn penderfynu le ti'n dechre sef *minus*

        pedwar a lawr fana alreit mynd lan neu lawr dibynnu be sy'n dod gydag e reit

        mae'n bwysig bod ni'n wneud y pedwar rheol adio tynnu lluosi a rhannu a pan

        ddowch chi i ddysgu cofiwch chi'n defnyddio hon pan chi'n adio a tynnu chi'n

        defnyddio y rheol dau *minus minus* a *plus* pan chi'n lluosi a rhannu OK adio a

        tynnu llinell rif lluosi yna y rheol bocs bach [inaudible]cofio hwnna.

P: Ydyn.

A1:   Cofio hwnna?

P: Ydyn.

A1:   Ie? Hwnna chi'n defnyddio pan chi'n lluosi neu rhannu OK cofio'r bocs bach yna.

        Reit. Credu bod ni bron â gorffen heddi ar rhein. Em pedwar a lluosi dau b lluosi

        tri c. Pwy sy'n cofio shwt i ni wneud hwnna te? Dechre P10.

P10:   Yfe em wyth dau ddeg pedwar a b c.

A1:   Oh gret ardderchog alreit? Dau ddeg pedwar a b c gret OK [inaudible] good da

        iawn pigo lan yn dda arno fe ardderchog. Lluosi'r rhifau jest rhestru'r rhifau yn

        dyfe. P16.

P16:   *Minus six* a b?

A1:   *Minus six* a b. Na ni chi wedi bod yn dda yn rhein o'r dechre y lleill ych chi'n

        trwblo am yn dyfe.

A1:   P19.

P19:   Yfe un deg wyth c a?

A1:   Eh shwt ti'n cael un deg wyth?

A1:   P.

P: Yfe undeg chwech a c?

A1:   Eh shwt ti'n cael un deg chwech P9?

P9:   Un deg dau a c.

A1:   Un deg dau a c oedd y gwaith caled yn iawn da chi wedi ei wneud ond dau tri
        chwech lluosi dau un deg dau yn dyfe na beth oedd ti di rhoi yr ail with ie?

P: Ie.

A1:   Na ni ac wrth gwrs mae dau *minus* felly mae'n troi'n *plus* nawr OK sef un deg
        dau a c good. Tries i dala chi mas fana jest rhoi dau fana ar ben ei hunan gwympo
        chi ddim amdano fe ware teg da iawn. Dau lluosi tri lluosi dau fel arfer a wedyn a
        c rhai o chi'n gweud c a ond does dim ots jest wi'n leco cael yn drefn y wyddor
        dimbyd yn haearnaidd abyti ni allwch chi wneud e mewn unrhyw drefn o ran cael
        e'n gywir jest arfer dda yw hwnnw. Reit beth yw hwn? P13?

P13:   Dau a

A1:   Dau a. [Inaudible]

P: a.

A1:   a

P: Un a

A1:   Un a.   [all Welsh pronunciation]

A1:   P12

P: a a

P12:   a

P: a

P: a

P: a

P: a

P: a

A1:   Pan wedis ti a a tro cyntaf oeddet ti nes ati pryd ni wedodd rhywun arall a a hefyd

        reit ti'n agosach ati pryd ni ond ni byth yn gweud a a na b b

        beth i ni'n gweud yn lle hynny yw a wedi sgwario

P: Sgwar

A1:   a *squared* OK

P: a neu a a?

A1:   Na jest a reit a a dau lan fana nawr sylwch y gwahaniaeth rhwng hwnna a hwnna.

        Faint yw hwnna?

P: a a

A1:   Nage. Hwnna yw dau a alreit hwnna yw dau a achos chi'n adio nhw chi'n cael un

        ac un arall yn wneud dau yn dyfe dau o'r un peth. OK. Ond hwnna reit chi ddim

        yn gweud a a chi ddim yn gweud dau a yn sicr ond ych chi'n gweud a sgwar a

        wedi sgwario achos mae'n lluosi dau beth yr un peth gyda'u gilydd ych chi'n

        galw e'n a sgwar. Ti'n cofio arwynebedd wnaethom ni ar ddechre'r flwyddyn. Os

        oes da chi ryw sgwar fel na i gael reit cofio wneud arwynebedd arwynebedd

        sgwar?

P: *Height times*

A1:   Beth yw e?

P: *Base*.

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A1:   *Base* na ti. *Height times base good* na fe sail lluosi uchder.

P: Hyd *times* lled.

A1:   Hyd *times* lled wel mae hwnna'n sgwar yn dyw e reit so os ych chi'n cofio os

        oedd e'n un os oedd e'n maint sgwar un centimetr o'n i'n gweud bod e'n un

        centimetr sgwar yn dyfe. Wel nawr os ydy e'n a *times* a ni'n galw e'n a sgwar or

        gorau taw ella bo hwnna'n help i chi gofio fe a *times* a yn a sgwar. So faint bydde

        a *times* b *times* a? Meddyliwch nawr cyn ateb meddyliwch cyn ateb. P20.

P20:   Em dau sori a sgwar a un b.

A1:   Bron bod.

P: a b sgwar.

A1:   a b sgwar bu'n ofalus.

P: a a sgwar times b.

A1:   a sgwar times b.

P: ab sgwar.

A1:   ab sgwar bu'n ofalus bu'n ofalus.

P: a sgwar em em

A1:   Beth yw e?

P9:   a sgwar b

A1:   a sgwar b

P: Yfe a b a wedyn tri bach?

A1:   Nage ddim cweit.

P: a sgwar b.

P: a sgwar b.

A1:   Reit ie chi wedi dechre latchio arno wedyn gaethom ni e. Ti oedd y cyntaf i weud

e yfe? Wedes ti b a sgwar ti wedodd b a sgwar P19?

P19:   [Inaudible] a b sgwar.

A1:   Reit [inaudible] b a sgwar eraill yn gweud a sgwar b na'r ateb cywir reit mae'r

ddau yn iawn b a sgwar hynny yw ych chi'n sgwario'r a lluosi'r gyda'r b achos

bod gyda chi a lluosi a OK so reit a *times* b *times* a *equals* a sgwar b neu b a sgwar

copiwch rheina lawr. [Inaudible]

Pedwaredd ar bymtheg.

P: A1 beth yw'r point?

A1:   Pardon?

P: Beth yw y point?

A1:   Beth yw point o be?

P: Beth yw point os [inaudible] *numbers*?

A1:   Na dim to wnawn ni wneud *numbers* wythnos nesaf. Alreit mae'r mae'r gwaith

hyn yn arwain at lot fawr o mathemateg eraill sy angen ei wneud OK so em

allwch chi weud beth yw point dysgu tablau chi'n dysgu tablau at wneud syms

gwahanol yn dyfe.

P: A1 fyddwn ni'n defnyddio hwn pan ni'n hynach?

A1:   Alleth fod alleth fod cwestiwn cwestiwn wi'n wastad yn gael a fyddwn ni'n

defnyddio hwn pan ni'n hynach? Wel mae pob un mynd i wneud pethau gwahanol

bydd rhai o chi sicr yn defnyddio fe bydd rhanfwyaf o chi yn defnyddio rhywfaint

ohono fe rhywfaint o algebra mewn rhyw ffordd neu gilydd.

P9:   Lorry driver.

A1:   Gallu fod gallu fod lot o waith cyfrifiada cyfrifo gyda os wyt ti'n lorry driver

gweithio mas y milltiroedd a pethau faint o betrol ti'n defnyddio pethau ma yn

gallu dod mewn yn handi iawn pryd hynny [Inaudible] OK. Chi di cael e lawr?

Canolbwyntio te [Inaudible]

P: A1 gallwn ni defnyddio *white boards* heddi?

A1:   Gawn ni weld mewn [Inaudible] symud ymlaen alreit eh tri a lluosi dau a.

Beth abyti hwnna te? Beth abyti hwnna P.

P: Chwech a sgwar.

A1:   Chwech a sgwar ti'n cytuno ie ti'n cytuno oes rhywun yn anghytuno? Da iawn da

iawn ni'n dechre siapo chwech a sgwar na fe chi'n dda gyda lluosi o'r dechre

chwarae teg chi wedi bod yn dda. Dere mlaen achan heddi nid fory. [Inaudible].

P9:   [Inaudible]

A1:   Pardon

P9:   Rhoi y [inaudible]

A1:   Ie. P8.

P8:   Yfe deg a sgwar ydy o?

A1:   Rhywun yn cytuno a hwnna?

P9:   Sai di wneud e to.

A1:   Good da iawn da iawn deg a sgwar b ardderchog ardderchog

P: A1 ie ond mae fod fel times rhwng yr a a b.

A1:   Ond wyt ti'n cofio pan oedden ni yn dechre ie ie galle fe fod fel na hynny yw alle

ni fod di dechre wn i be sy da ti dechre gyda pump *times* a *times* b yn dyfe dechre

gyda hwnna *times* dau *times* a reit dechra gyda hwnna ond gyda rhain nawr yr un

peth a lan fana o'n i ddim di rhoi dau *times* a tri *times* a fana o'n i o'n i jest wedi

dechre gyda tri a hynny yw o'n i di wneud y rhan cyntaf i gyd fel petai OK na'r

gyd yw e rwy'n meddwl hynny yw os wyt ti'n cael pump a b mae'n meddwl

pump *times* a *times* b. Pan byddwn ni'n dod oedd P1 yn gofyn abyti *numbers* reit

byddwn ni'n dod wythnos nesaf i rhoi rhifau mewn iddo fe reit wel byddi di'n

gweld hwnna byddi di'n gwybod o bod e'n lluosi [unclear] ti'n deall. OK jest.

Chi'n cofio beth oedd y term iwsies i yn y dechre defnyddio ni yn y dechre sim

Ps: *Simplify*.

A1:   *Simplify* symleiddio yn dyfe reit na beth i'n ni'n wneud ni'n symleiddio ni'n

sgwennu lawr mewn ffordd mwy syml mwy cyfleus or gorau so ni'n cael cael

hwnna mae'r times wedi cael ei hebgor yn barod so ni roi fe mewn fana a ni jest

cael gwared a'r un sydd ar ôl. OK?

P: A1.

A1:   Ie.

P: Chi'n gwybod pryd chi'n symleiddio pethau yfe fel i wneud nhw'n rhwyddach?

A1:   Ie buaswn i'n meddwl.

P: Wel sa algebra yn rhwydd.

A1:   Na falle na ond i'n ni'n wneud e'n rhwyddach na mae fe'n edrych fel i ddechre

ti'n weld hynny yw pan wyt ti'n cael pethau fel tri a plus pedwar a wel mae saith

a yn rhwyddach yn dyfe ie OK beth i'n ni'n wneud falle bydde em yn cystal

gweud bod ni'n wneud e yn fwy cyfleus ond mae'r gair symleiddio yn cyfleu

[inaudible]

P: Ond beth os oes rhywun ddim yn deall algebra?

A1:   Wel mae nhw'n cael dod i'r dosbarth yma wedyn i gael dysgu gennych chi.

Alreit.

P: OK.

A1:   Reit wi mynd i *stretchio* chi nawr. P18 *straight* lan go on.

P18:   Chwech a sgwar b sgwar.

A1:   Oh ffantastic ffantastic chwech lluosi'r *numbers* i gyd dau lluosi tri tri lluosi dau

lluosi un lluosi un yn wneud chwech as a *times* a yn wneud a sgwar a'r bs b *times*

b yn wneud?

P9:   a sgwar b.

A1:   A sgwar b sgwar ie. Reit iawn P15 P15 wyt ti sori P15 OK iawn pawb yn hapus?

Chi'n gwennu chwarae teg chi yn wneud yn dda. Ydy hwnna yn glir? Darllen

hwnna beth mae hwnna'n gweud eh P9 darllen e'n llawn dim symleiddio fe

darllen e'n llawn.

P9:   *Two times* a *times minus* a.

A1:   Reit OK iawn chi yn darllen e'n iawn. OK beth yw e te? P7?

P7:   Yfe *minus two* em a sgwar?

A1:   Oes rhywun arall yn gweud hynny?

P: [Inaudible]

A1:   Good. Rhywun yn gweud rhywbeth arall?

P: [Inaudible]

A1:   Eh?

P: Yr un wedodd chi gyntaf.   [Possible reply]

A1:   *Minus* achos mae un *minus* da ni. *Minus* dau a sgwar OK? Reit? Chi'n dda chi'n

        dda iawn.

Pupils work quietly.

A1:   P14. Wi' clywed ti fan hyn wi'n troi fel na ddim yn gweld ti bob tro.

P14:   Em *six* a sgwar b b eh sgwar.   [Numeral in English letters in Welsh]

A1:   Cwbl? Ie ti'n eithaf iawn eithaf iawn da iawn smo chi moen rhoi rhagor ych chi?

P9:   Na na.

A1:   O'ch chi mynd i weud rhywbeth nawr beth o'ch chi mynd i weud?

Ps: *Minus. Minus.*

A1:   Na mae dau *minus* da ni yn dyfe.

P9:   O'n i mynd i weud plus ar dechre [Inaudible].

A1:   Ie [unclear]mynd i weud gair [unclear] peidiwch â na os cowntwch hwnna os oes

        eilrif o *minus'* da chi mae'n *plus* os oes odrif o *minus'* mae fe'n *minus* yn dyfe OK

        da iawn da iawn reit na ti [inaudible] ti'n wneud yn gret. Reit gewch chi wneud

        rhein te eh yn dawel wnai pump neu wech lan wedyn gewch chi wneud rhei a ni

        clywed atebion. Em.

Questions written on the board pupils work quietly.

A1 helps individual pupils.

A1:   Reit te ni di gorffen?

P: Na.

A1:   Ble ti cyrraedd P3?

P3:   Pedwerydd un.

A1:   Pedwerydd ie? Dau funud to te.

A1:   Reit.

        Gorffen?

        Reit te eisiau marcio rhain.

        Eh dechreuwn ni gyda P3.

P3:   Em *minus* a b.

A1:   *Minus* a b iawn marciwch rhein nawr te i ni gael gweld pwy sydd wedi cael nhw

        gyd yn iawn. Eh awn ni nôl at P1.

P1:   Em *six* a *times minus two* b.

A1:   Ie checko'r swm yna *six* a *times minus two* b beth abyti'r a arall?

P1:   Oh.

A1:   P16. Be sy da ti?

P16:   [Inaudible] Deuddeg a b

A1:   Deuddeg a b. Jest deuddeg a b. Be sy da ti P21?

P21:   Em *minus twelve* b a em square [d?]

A1:   [Inaudible] OK. *Minus* achos hwnna ti'n gweld P16 un *minus* fana *twelve* yn iawn

        em da ti a a b yn iawn em na dim a b sori mae dwy a yma

Ps: a *squared* b.

A1:   a *squared* b yn dyfe sori. a *squared* b. Reit pwy gafodd hwnna'n iawn. OK

        [Inaudible] Reit ti'n deall nawr P16? OK P1? *Two four four threes twelve* a *times*

        b *times* a yn a *squared* b a wedyn *minus*.

P: A1 dwi em *twelve* a *squared minus* b.

A1:   Dim dim *minus* b mae rhaid i'r *minus* mynd yn ffrynt OK mae rhaid i'r *minus* fod

        yn ffrynt na beth yw e OK. Em P21. Na P15 wi di clywed wrtho ti o'r blaen. Gad

        i ni cael clywed bach wrth P15.

P15:   Sai di wneud hwnna.

A1:   Dim di wneud hwnna oh alreit geiff P21 wneud e.

P21:   Eight b c a *squared*.

A1:   b c a *squared* rhywbeth arall?

P21:   *Eight*.

A1:   *Eight*. [inaudible]

P9:   Wi rhoi *eight* eh *eight* a *squared* b.

A1:   Os nad oes c da ti mae'n *wrong* [inaudible] a *squared* ar y blaen wi'n hapus da

        hwnnw.

P: Na be roes i.

A1:   Os oes gyda chi hwn wi'n hapus. Wi'n hapus â hwnna. Ie plis os nad ych yn siwr

        yr ateb sy gyda chi yn anghywir dim cweit yr un peth meddyliwch reit dyw trefn

        ddim yn bwysig.

P9:   Beth os ni'n anghofio rhoi llythyren mewn?

A1:   Mae'n *wrong* rho fo mewn. Alreit eh gofyn i P11 ble mae P11 te?

P11:   *Minus twenty four* a *squared* b.

A1:   Eh *minus* ble da ni *twenty four* wedes ti sori *twenty four* a *squared* b na be wedes

        ti?

P11:   Ie

A1:   Ti'n iawn hefyd. Rhywun arall yn iawn? Dyw good. P5

P5:   *Twenty four* a *squared* b *squared*.

A1:   *Twenty four* a *squared* b *squared*. Chi'n cytuno da P5?

        Nawr te P2 rwy'n credu sydd nesaf heddi.

P2:   *Minus* a b c.

A1:   *Minus* a b c pwy gafodd hwnna? Be sy da ti P?

P: a b c.

A1:   a b c tri *minus* sydd fana mae dau yn wneud *plus* a wedyn ti *plus* lluosi *minus* OK

        hapus â hwnna ie OK. Pawb yn hapus? Pwy gafodd nhw gyd yn iawn? Un yn

        anghywir? Oh da iawn da iawn alreit chi'n cael hawl i gael un yn anghywir.

P9:   Dau yn anghywir?

A1:   Dau wi dechrau poeni abyti chi wedyn. Gath rhywun dau? Ges ti dau? Ti'n siwr

        bo ti'n deall pam? Mm?

P9:   Mm.

A1:   Ie OK. Rhywun â mwy na dau? Be gest ti?

P: Tri.

A1:   Tri yn anghywir. Ti'n trio cywiro nhw? Ti'n deall ble est ti'n *wrong*? Siwr?

P9:   Ie A1 dau yn anghywir dim dau yn iawn.

A1:   Ie. Reit te wnawn ni cwpl bach ar byrddau to i jest cael gweld a wedyn wnawn ni

        tipyn bach o rannu. Reit dim ond tri bach wi am wneud nawr. *Quick fire* nawr. Eh

        minus two a *times minus three* b. Ar y byrddau.

Ps: Oh.

A1:   Wedes i ar y byrddau.

A1 helps individual pupils.

A1:   Siwr abyti hwnna?

Siwr abyti hwnna? Ie. Siwr? Pam ti'n rhoi *minus* tu blaen? Mm.

P: Oh mae'n wneud *plus* yn dyw e.

A1:   Mae da fi dau *minus*. Ble ti'n cael pump b ta P9? OK rho fe lawr. Rho fe lawr.

Na na *times* yw e yn dyfe *times* yw e. OK. Mae hwnna'n rhwydd i cwympo mewn

iddo.

A1:   Reit chwech a b yw'r ateb i fod.

P: Ydy'r plus

A1:   Ie *plus* o'i flaen e.

Chi'n cwato'r bwrdd wrth P8 fana. Rhowch eich byrddau lawr dangoswch nhw

lan fana na gyd 'sdim eisiau *waveo* nhw. [Inaudible]. Iawn sai di gweld dim un yn

anghywir fan hyn. Na ti good reit iawn.

P9:   Wyth yw hwnna? Na *times*

A1:   Pardon?

P9:   *Times*.

A1:   Mae dy ddychymyg di yn rhedeg yn chware triciau arnat ti wi'n credu.

A1 helps pupils.

A1:   Reit tri tri naw dau naw un deg wyth a sgwar b sgwar. Reit na fe lawr yn y llyfrau

te. Iawn stopwn ni am funud fana wi moen jest son wrtho chi abyti rhannu. Reit

pawb di cael hwnna lawr OK. OK. Shwt allwn ni symleiddio hwnna nawr rwy'n

credu bo chi di gweld fi'n sgwennu rhywbeth tebyg i hyn eh i feddwl abyti yn

barod sut allwn ni symleiddio a rhannu gyda b wneud iddo edrych yn fwy syml

wneud e edrych yn rhwyddach. Fel o'n i'n symleiddio a b sori a times b i fod yn a b shwt byddwn i'n symleiddio a rhannu gyda b P11?

P11: Un rhannu da un.

A1: Na wi moen a a b yn yr ateb.

P: Un a rhannu da un b?

A1: Ie ond dyw hwnna ddim yn wneud e'n symlach nady mae'n wneud e yr un peth mwy o inc a gweud y gwir.

P9: a b

A1: Ond mae hwnna yr un peth â lluosi.

P9: Ie.

A1: So os dwi moen gwahaniaethu rhwngddynt nhw.
Go on.

P: O'n i mynd i gweud b a.

A1: Moen yr a a b yn yr ateb ond fi ddim eisiau yr arwydd rhannu yna.

P: Hanner a a hanner b?

A1: Hanner a a hanner b shwt ti'n cael hanner na ddim cweit. Wel fel hyn i ni'n wneud a dros b alreit a dros b. Chi'n cofio ym mlwyddyn saith oeddech gweud oeddech chi'n dysgu abyti ffracsiynau bod un dros dau yn un rhannu gyda dau reit gweithio hwnna mas fel degolyn fel decimals bydde chi'n gweud un dros dau un rhannu gyda dau bydde chi. So fel na i ni'n mynegi yn mathemateg ni'n mynegi algebra ar ffurf rhannu.

P: Copio hwnna lawr?

A1: Copio fo lawr ie.

P: Yn y llyfr?

A1:   Yn eich llyfr ie sdim pwynt cael e ar y bwrdd.

P: Ar y bwrdd?

P: Nace.

A1:   Yn y llyfr tim yn mynd a'r bwrdd gartref.

        Ie P4.

P4:   [Inaudible]

A1:   P18.

P18:   Yfe tri a b.

A1:   Mm?

P18:   Tri a b.

P9:   Tri a b

P: Yfe tri a a wedyn b?

A1:   Ie dros i'n ni'n gweud.

P: Tri a dros b.

A1:   O'n i'n meddwl good da iawn da iawn P8 o'r diwedd [inaudible]. Reit allwch chi

        dechre gyda hwnna os d chi eisiau chi'n dechre gyda hwnna ond i ni'n gallu

        rhannu'r chwech a'r dau yn dy ni. Dau mewn i chwech tri bydd genai tri a dros b.

        OK?

P: Ydy hwnna yr un peth a dweud tri a b.

A1:   Na dyw e ddim yr un peth a tri a b. Mae tri a b yn meddwl tri a lluosi gyda b yn

        dyfe.

P9:   Ni'n rhoi y dau ateb mewn?

A1;   Sori?

P9:   Yfe rhoi y dau ateb mewn?

A1:   Ie rhoi y dau ateb mewn i chi gael gweld bod le i ni'n cael y tri. Reit ni'n rhannu y

        chwech gyda dau. Fel i'n ni'n trin y ffigurau arwahan wrth lluosi ni'n trin nhw

        arwahan nawr wrth rhannu yn dyfe. Nawr te mae gwaith cartref da fi i chi.

Ps: Oh.

A1:   Ych chi fod mynd yn *excited* abyti hwnna.

Ps: Yeah.

        Gwaith cartref yn barod.

        Pupils discuss amongst themselves.

A1:   Erbyn wers nesaf ie.

A1 advises pupil.

Erbyn dydd Llun os gwelwch yn dda.

        Approximate percentage inaudible/unclear words 0.8

Gwers 3 Athro A2 Blwyddyn 10 Amser 9.10am [Heb ficroffon personol]

Lesson 3 Teacher A2 Year 10 Time 9.10 am [No personal microphone]

A2:   Gewch chi farcio y gwaith cartref a wi'n gwybod bod rhai o chi wedi cael trafferth ond wnewch chi gopio yr atebion mas pob un o chi i bob cwestiwn fel bod yr atebion gyda chi wedyn ar gyfer gwirio.

Pupils working.

A2:   Iawn cwestiwn un [inaudible] gan mod i'n gwybod bod rhai o chi wedi cael

trafferth gyda'r gwaith hyn iawn wnewch chi rhoi eich llaw lan am yr atebion am

heddi os gwelwch yn dda un a P2

P2:   Un pwynt pump.

A2:   Kilo Un b P5

P5:   Five point one four.

A2:   Na ti *five point one four kilograms*. Felly fana oedd lot o waith yn doedd e. Oedd

e'n gweithio allan i fod yn gywir yn bump pwynt un pedwar neu oedd ti'n gorfod

talgrynnu fe?

P: Em [inaudible]

A2:   *Exactly five point one four*.

P: *Yeah*

A2:   OK. *Part c somebody else please*. For the cyfwng dosbarth ble mae'r canolrifau?

Chi [ofni?] gweud wrthai? P2.

P2:   Four [inaudible] Four

A2:   Em ateb d yw hwnna reit ateb c

P: Tri.

A2:   Na.

P: Pump.

A2:   Ie ie pump i chwech reit yr un sy'n sôn am o bump lan i chwech reit dyna ond fel
        wedis i ar hyn o bryd wi ond yn rhoi yr atebion i chi and part d is the one from
        four to five dyna le mae'r dosbarth iawn gadewn ni'r darn arall am y tro achos
        rwyn credu trafferth chi'n cael ar hyn o bryd yw darganfod y tri peth hyn. Iawn
        ten cwestiwn pedwar rhan a rhywun plis helo sut ydych chi heddi P3.

P3:   Cant dau ddeg pump litr.

A2:   Cant dau ddeg pump litr na ti a wedyn b rhywun arall plis. [rwy'n gweld atebion o
        blaen chi'n ofn ofni dweud ?] P12 oes ateb da ti?

P12:   Cant pump deg tri [inaudible]

A2:   Na ti ac os wyt ti'n talgrynnu fe mwy na thebyg mae'n dod i hwnna? *That's the
        answer to one decimal place*? OK? Em *part c part c* ateb da ti P6?

P6:   *One hundred and forty five*.

A2:   Na ti em ti [ddim yn gwneud] beth mae'n gofyn ie ti'n gwybod mae'n gofyn am y
        dosbarth felly yn lle dweud yr un canol ti'n dweud mae e rhywle mewn yn y
        dosbarth so ti di meddwl e mas yn iawn ond mae angen gwybod o ble i ble *and
        therefore it would be the block one forty* fel na bydde fe'n ymddangos yn y tabl
        reit *we need the class interval the modal class* da iawn. reit mae un peth arall yn
        does ne yr arolwg ar y diwedd. *By the way I want you all to copy these answers
        out because we won't have time to go over each one we are going to do one of
        them so I want the answers copied so that you can check.* Iawn reit yr arolwg *right
        the question the review* iawn ateb da rhywun yn rhan a plis. Oes ateb da ti P19?

P19:   [Inaudible]

A2:   Pardon.

P19:   [Inaudible]

A2:   Chi'n ofni'r gwaith ma yn fwy na dim yn dy'ch chi. a b *the next part part b four point zero seven c* nawr mae hwn yn gofyn am y dosbarth modd *the modal class.* Ie P20 P10 be sy da ti.

P10:   Pedwar [inaudible]

A2:   Na ti pedwar lan i pedwar pwynt pump yn dyfe mae'n cael ei sgrifennu lawr fel hyn *four less than or equal to h less than strictly less than four point five.* So na hwnna mae un rhan arall d y cyfwng dosbarth canolrifol ble mae hwnnw? Ble mae'r *where is the eh class?*

Ps: [Inaudible]

A2:   Yr un dosbarth eto. Reit dod o gwmpas i gael rhyw fath o syniad

A2 helps individual pupils.

A2:   Ti'n alreit.

        Ti'n alreit ambell i beth ie.

        Beth amdanat ti?

Individual tutoring. [Away from the floor]

A2:   Nawr te iawn mwy neu lai chi'ch dau hanner mwy na hanner?

P: Canolbwynt [off floor]

A2:   Oh ie ti di rhoi fe yn y canol o smo hwnna'n [inaudible] mae hwnna'n mwy neu lai 'na ti di ti di ti di deall be sy eisiau wneud ond ti di rhoi fel wedodd y [inaudible] fan co yn dyfe.

A2:   Reit dyma be dwi'n bwriadu gwneud. Rwy'n mynd i wneud rwy'n credu y

        cwestiwn olaf achos bydden i'n meddwl mynd o gwmpas mae lot o chi wedi

        mynd eithaf pell gyda'r cwestiwn cyntaf a fel mae'n mynd mlaen i chi di wneud

        llai a llai felly hwnna dwi mynd i wneud. Ond mae na rai o chi wedi llwyddo

        mwy neu lai i gael pobpeth yn iawn felly fe allwch chi fynd at y daflen

        ffracsiynau reit ond wi am i chi gyd fynd at y daflen yne am funud er mwyn i chi

        cael gwybod pwy gwestiynau dwi am i chi wneud bydd tipyn bach yn llai da [P]

        ond bydd gen ti fwy i wneud o rhein yn bydde [P] iawn ie smo ti di cael un af i

        nôl un i ti wedyn.

Pupils discuss work.

A2:   Reit er mwyn i ni deall ein gilydd sh dyma'r cwestiynau ydw i am i chi wneud a

        bydda i'n cymryd y daflen hyn i mewn wythnos nesaf. Un neges mae pob un o'r

        cwestiynau hyn i'w wneud heb gyfrifiannell reit.

P1:   Ha Ha.

A2:   Nawr falle bo chi iawn P1? Falle bo chi am farcio yn eich ar y taflenni nawr dyma

        nhw un ab tri wech abc ch bydde fe yn Gymraeg mae'n siwr mai d fydde fe yn

        Saesneg siwr o fod naw un deg tri abc un deg pedwar abcch neu yn Saesneg

        bydde fe'n d a cwestiwn un deg chwech. Reit dyna beth dwi am i chi wneud.

        Ydy'r daflen gyda ti? Na. Heblaw am P15 a P22. Reit oes na rhywun arall heb

        daflen

P1:   Fi

A2:   Oeddech chi ma ddo.

A2 helps pupils.

A2:   Nawr te hefyd wnewch chi rhoi neges yn y llyfrau cyswllt os gwelwch yn dda bo

hwnna fod cael ei wneud erbyn dydd Mawrth nesaf reit llyfrau cyswllt os

gwelwch yn dda y rhifau yna yn unig heb gyfrifiannell reit y rhifau na heb

gyfrifiannell erbyn dydd Mawrth nesaf llyfrau cyswllt chi'ch dau plis.

P1:   Erbyn pryd A2? Dydd Mawrth nesaf?

A2:   Dydd Mawrth dydd Mawrth nesaf.Wyt ti wedi copio y gwaith y rhifau lawr P1?

P1:   Na na wnai wneud e nawr.

Pupils work quietly

A2:   Reit ten dyna y rhai chi fod wneud tri i gyd ie tri a naw i gyd a un deg chwech i

gyd iawn. Reit cwestiwn olaf fi mynd i os nad ydych wedi ei wneud yn barod

wnewch chi roi'r tabl yn barod os gwelwch yn dda ni'n wneud y cwestiwn olaf y

cwestiwn arolwg a wnewch chi w pwy dudalen oedd yn y llyfrau Saesneg?

P: Pedwar tri pump tri saith

A2:   Pedwar tri saith pedwar tri saith. Nawr a cofiwch i chi'n creu colofn ychwanegol.

Copiwch y tabl mas hon yr arolwg y review. *Now make one more column and two

extra rows OK*. A tra bo chi'n wneud na wnaf i e yr un pryd. Un dau tri pedwar

pump chwech saith faint sydd yna? Gormod.

P: A2.

A2:   Ie. Os ych chi yn hapus iawn ac yn deall y gwaith hyn chi'n gallu cario mlaen da'r

daflen neu pan da chi'n dod i'r darn da chi ddim yn deall byddwch yn clywed fi

beth bynnag reit un dau tri pedwar pump chwech saith wyth faint sydd da fi nawr?

Un dau tri pedwar pump chwech saith eisiau un arall. Rwy'n siwr bod ffordd

cloeach i wneud hwn chi'n gwybod ond fi ddim wedi meistroli fe to. Iawn nawr te

ma da ni hyd rhywbeth yn does ne hyd hyd wedyn faint ohonyn nhw mi roi i

mewn nifer fan hyn.

Interruption.

A2:   Copiwch chi o'r llyfr os gwelwch yn dda alreit achos dwi'n eh wedi wneud rhein

ychydig yn fach.

Pupils working silently.

A2:   Reit.

P: A2 allai gael llyfr newydd plis?

A2:   Gelli.

A2:   Tri i gyd ie os nad ydw i di [inaudible] mas tri.

P: Twelve percent of

P: Edrych ar y *working*

P: Ie fel na.

P: Mae'n gofyn *twelve percent of*

Nage *twelve percent of* achos *twelve percent equals*

A2 addresses all

A2:   Iawn erbyn hyn wi di bod yn weddol dwy ieithog lan fan hyn reit ond eh

P1:   A2 sori beth mae *descending* yn meddwl?

A2:   Dod lawr.

P1:   Dod lawr so fel *nineteen nineteen* ten.

A2:   *Eighteen* ie mae'n dibynnu fel ma faint mae'n dweud. Reit mae[inaudible] yn

sefyll am hyd gad i fi gweld be mae hwn yn siarad abyti mae tabl hwn hyd y ceir

reit l *therefore stands for the length of the cars* h hyd y ceir. Nifer y ceir mae'n

defny defnyddio yn eich llyfrau chi amledd neu *frequency* siwr o fod iawn nifer y ceir number of cars canolbwynt byddai'n rhoi mewn fan hyn mid-point a wedyn yn y darn olaf byddwn ni'n lluosi nifer y ceir gyda'r canolbwynt *multiply the number of cars by the mid-point*. OK nawr te P4 *what is the mid-point in the first class interval? Mid-point between three and three point five.*

P4:   *Three point two five.*

A2:   *Three point two five.* Sh sh shwt i ni mynd i checkio bod ti'n iawn

P4:   Adio fe [laughter]

A2:   Ne neu shwt t weithiest ti fe mas? Neu oedd e'n wneud synnwyr i ti?

P4:   Ie just fel [inaudible]

A2:   Oedd ti'n gweld o'n syth neu od nad oeddet yn gweld o'n syth fe alli ti adio tri a tri pwynt pump

P: lluosi fe

A2:   I wneud chwech pwynt pump na adio fe a wedyn rhannu da dau reit rhannu da dau OK? *So the mid-point is three point two five. The next mid-point P17*

P17:   *Three point seven five.*

A2:   *Three point seven five. The next mid-point* pwy arall sy'n gweithio da fi fan hyn nawr? P8.

P8:   *Four point two five.*

A2:   *Four point two five. The next one eh P21 what's the next mid-point?*

P21:   Em *four point seven five.*

A2:   *Four point seven five.* Yr un nesaf wedyn em P22 beth yw'r canolbwynt nesaf?

P22:   *Five point two five.*

A2:   Na ti *five point two five*. A'r un nesaf wedyn em P18?

P18:   *Five point seven five.*

A2:   *Five point seven five* iawn? Nawr os ydych chi moen be da chi'n trio gweithio

        mas nawr yw cyfanswm hyd y ceir da chi'n rhoi'r ceir i gyd ben i gwt beth yw

        cyfanswm y hyd. *Now you assume that you have because you have twenty one*

        cars between three and three point five you estimate that the length of the car is

        three point two five metres and therefore here the total length of those twenty one

        cars be ni'n wneud? Lluosi ni'n lluosi dau ddeg un gyda tri pwynt dau pump.

        Felly eich cam nesaf gyda eich cyfrifiannell os gwelwch yn dda lluoswch nifer y

        ceir gyda canolbwynt reit *and write the answer in there multiply the length of the*

        car by the mid-point every time.

Pupils work quietly.

A2:   Be sy da chi nesaf be sy da chi nesaf plis? Dod lawr.

        Descending yw dechrau da'r mwyaf a symud i lawr beth yw'r gair Cymraeg sain

        cofio nawr em cynyddol esgyn nage

P: Esgynnol.

A2:   Nage esgyn yw mynd fyny.

P: Disgyn.

A2:   Lleihau lleihau lleihau. Pwy cwestiwn da chi'n wneud? Chwech rhestrwch y eh

        disgynnol disgyn dod lawr disgynnol rhestrwch y canlynol yn y nhrefn disgynnol

        so felly y mwyaf cyntaf wedyn yr un llai ie P1?

P1:   A2 can I have some help?

A2:   Wyt ti yn y sheeten?

P1:   Ie fi ar y sheeten.

A2:   OK. Em oes rhywun wedi gweithio rhein mas i gyd? P19 elli di rhoi yr atebion

fan hyn mewn fana plis.

P: Mae P8 wedi a fi.

Pupils working on task. [Following words heard intermittently as pupils work]

P: *Eight take away five is three.*

P: *Take away* yw e

P: Nage ddim

Ps: *Hundred and eight*   Away from the floor.

        Four hundred and eight

        Four hundred and eight

        Four hundred and eight yeah.

A2:   Iawn chi'n cytuno â rhein P18? Iawn? Now then oh ydy e'n gofyn gyntaf am y

        cymedr Em *first part find the mid-point of the first class interval oh well part a*

        that is three point two five. Part b what does it ask for? The mean length of the

        cars nawr te P4 be sydd eisiau wneud? Mae angen ffeindio cymedr. Nawr ti isio

        mwy neu lai ffeindio mas cyfarteledd cymedr cyfartaledd hyd y ceir. Be ti mynd i

        wneud? Adio rheina gyd lan ie a rhannu gyda beth a faint yw'r amledd? Cant yw

        e yfe? Nawr te nôl at y tabl be sy'n mynd mewn fan hyn?

P: *Hundred.*

P: Cant.

A2:   Cant pam?

A2:   Cant o geir sydd yfe? Iawn. A beth sydd mynd mewn fan hyn?

P: *Four hundred and seven.*

A2:   *Four hundred* a be sy da chi *four hundred and seven*. Hwnna?

P: Ie

A2:   Iawn. Nawr shsh Beth mae hwnna' n golygu ar y funud. Dwi moen i chi edrych ar

        y golofn olaf. Beth yw ystyr y cant? Mae gyda chi gant.

P: O geir.

A2:   O geir. Beth yw ystyr pedwar cant a saith. Dyna

Px: *Frequent* na Amledd *times* canolbwynt. **[Px=The same unidentified pupil]**

A2:   Ie. Be mae'n dwi'n cytuno be ti'n dweud ond elli di roi fe mewn geiriau bob

        dydd. Beth yw ystyr y pedwar cant a saith? Pedwar cant a saith beth yw?

Ps: *Metres*.

A2:   Ie na ti. Nawr te mae'n bedwar cant a saith metre felly be mae'n golygu? Mo

        belled a'r ceir yn y cwestiwn beth mae'n golygu?

Px: Faint yw hyd e.

A2:   Faint yw hyd?

Px: Y car.

A2:   Y ceir i gyd na ti faint yw hyd y ceir i gyd felly be ti'n wneud nawr te i ffeindio'r

        cymedr to find the mean what do you do?

Px: *Four hundred and seven divide by a hundred.*

A2:   *Four hundred and seven metres divided by a hundred* a sdim eisiau cyfrifiannell

Px: *Four point o seven.*

A2:   *Four point zero seven metres*. Wrth gwrs wnes i ddim trafod heddi cyn dechrau

        beth fydde chi'n amcangyfrif iddo fe fod. Dyma le mae'r ateb yn agos iawn i'r

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dechrau y dosbarth hyn. Agos iawn i'r dechrau. *You see most of the cars are in here*. Sdim lot o geir yn fwy *so the mean is just in there four point naught seven*. Be mae'n gofyn P4?

P4: *Modal class.*

A2: *Modal class most popular class.* Shsh allwch fi'n gwybod bod chi'n weithgar os gallwch chi cadw'r swn lawr tamad bach. P8 *what is the modal class*?

P8: [Inaudible]

A2: Ie yr un hwn. Achos mae hwnna yn golygu *most popular.*

P: *Group.*

A2: *Class.* Mo yn mynd ym modd a mode. *And finally part d median class interval OK. How do we go about that? How many cars did we have all together?*

P: *Hundred.*

A2: *Hundred. If you put the cars in order from the shortest to the longest is there going to be a a one middle car.*

P: *No*

A2: *No. Ok so what do you do? This is now part d.*

P: *Fifty and fifty one.*

A2: *We divide hundred by two to get fifty so it's the fiftieth and the fifty first that we are looking for. Now where are they? We've got twenty one cars up to there. How many cars do we have we have thirty five cars up to there. How many cars do we have which are still less than four point*

P: *Eighty seven.*

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A2:   *Eighty seven and therefore where is the fiftieth and the fifty first where are they*

        going to be? In which class?

Ps: [Inaudible]

A2:   Yeah *same class* again. Felly P4 ti ofynnodd i mi gyntaf wyt ti'n teimlo chydig yn

        fwy hyderus a byddi di yn gallu mynd nôl a ceisio rhif pedwar wel a un falle ie?

P4:   Ie.

A2:   Reit mae'r gloch ar fin mynd.

Approximate percentage inaudible/unclear words 0.5%

Lesson 2 Teacher C1 Year 8 Time 11.10 am. [Without a personal microphone] Micro audio recorder placed near small groups.

C1:   Others of you will have different learning styles. Hopefully there's been

something in all these lessons we've done over the last few weeks to appeal to

everybody. This is the last of them and this hopefully will appeal to people who

are musical. OK because we're going to be doing some maths which will be

related to music. Now you just need to listen carefully to start off with all right

and then once you know what you're doing it's just a matter of working through

it. There's a work sheet which you need to to have a copy of follow through and

you write answers on the worksheet as you go through so you'll need a pen or a

pencil available all right it doesn't matter what one or the other. I'll come back

with the worksheet once you've logged on don't do anything else yet until I tell

you what to do.

Children given help to log on to the computers.

S1:   Just ignore that.

C1:   You're not going on.   **Not on floor**

S1:   You have to log back on again. No just pretend it's not there.

You'll have to log on a second time.

C1 addresses whole class.

C1:   Right. When you plug the headphones in they go in the back of the computer but

do it carefully please. Don't bang them in.

P: C1 in the green one?

C1:   The green one.

S1:   Small green ports.

C1:   Small green one.

C1:   The reason you've got headphones is you're going to being composing some music and you'll need to listen to the music you're composing at one point. Right if you just not put the headphones on for a minute so you can actually hear me. You won't need them for a while. P14 headphones off.

P: C1.

C1:   Now what you'll be doing if you look at the eh the sheet I've given you first of all if you write your name on the top

P: C1.

C1:   I will be collecting these in later.

P: C1 I haven't had a sheet.

C1:   Oh sorry. You need to you need to go on to an internet site. So you need to eh click on internet explorer

P: It says access [inaudible].

C1:   You em you should see an int a web site address at the top of your worksheet point one go to web site w w w dot

P: It's on it now C1.

C1:   study works on line dot com.

P: Where C1?

C1:   So you can type that in please.

P: What was it C1.

C1:   Top of the worksheet. Might take a little while to get there.

Now really it's just a matter of following through the instructions on the

worksheet and when you get asked questions em there are spaces on the

worksheet for you to write your answers OK and I think the best thing is if I let

people get on with it and eh if you've got problems whatever put your hand up

and I'll come and help you. You will also need during this lesson two dice and I

will come round with those in a minute you don't need them straight away. So

basically Mozart I'm sure you've all heard of Mozart famous composer from a

couple a hundred of years ago. He actually wrote a type of music called a minuet

which is a form of classical music and he actually produced this way where you

can compose your own minuet by simply rolling dice and according to the

numbers that come up on the dice you select bars of music. You know that music

is split up into bars.

P: Yeah.

C1:   Some of you will have more musical than others. But but music is split up into

bars and a bar is a like a sentence of music. OK and Mozart wrote seventeen bars

of music I think was it or something different bars of music and these bars of

music can be put together in any sort of order and whatever order you put them

together in they're supposed to sound good OK. So what you'll be doing is rolling

dice and according to the dice scores you'll be selecting bars of music on the

computer and the computer once you've selected all of them the computer will

then play it back to you that's why you've got the headphones so you can hear

what your computer is playing and it should sound good whatever combination of

eh bars that you've selected. I tried it out myself OK and I found it quite

enjoyable and really interesting all right. And then you go on as as the page

progresses you go on to discover more about the maths involved in it and how

many different ways there are of composing these different minuets and so on.

It'll probably take you the whole lesson to get through the whole sheet if you do

finish early let me know and I'll come and give you something else you can do to

take you up to the end of the lesson. So once you're on the main web site which I

hopefully you're on now if you go to the em top of the screen you'll see a label

that says explorations so you click on explorations at the top there and then down

the left hand side of the screen you'll see a label math explorations this is an

American web site and they call it math not maths they don't put the s on the end.

OK so it's math explorations down on the left hand side. Once you've double

clicked on that or click on it once I think scroll down and you should find

something called math a la Mozart. Or music and math a la Mozart OK and a

picture a cartoon picture of Mozart there right. You click on that and then you're

into the site that you need to be into and basically follow it through then. OK if

you get stuck or get problems put your hands up and I'll come round and help.

P: C1 are we allowed to compose

C1:   Yes you will do.

P: C1 can't hear anything.

C1:   You won't straight away.

C1 helps pupils.

Problems with the sound.

P: C1 which one do you choose out of these?

C1:   Pardon?

P: How do you choose out of

C1:   Can anybody hear anything?

Ps: No No

C1:   Can you hear it?

       Who can hear the music? P9 can.   **[Mixed responses]**

C1:   If you can't hear it just move on for the time being all right and try and do the

       next.

Computing assistant S2 helps out.

C1:   When you roll two dice and add the numbers together how many different

answers are there?

P: There's em [inaudible]

C1:   Are you sure? What scores can you get when you roll a dice.

P: [Inaudible].

C1:   Right how many is that?

S2 explains web site needs an additional plug in.

C1:   Oh well.

       Right it looks like we're going to have to do it without listening to the music I'm

       afraid sorry em it worked when I tried it on my lap top upstairs but apparently my

       lap top has something on it that your computers haven't. So I'm sorry about that

       but you can still work through the web site and compose the music you just won't

be able to listen to it OK. Em you can still do the dice rolling and everything else and fill in the answers on your answer sheet.

P: C1 how does P9 hear it?

C1:   She must have something on her computer the rest of you haven't got.

Who hasn't got dice I've left some dice upstairs.

Pupils work through the handout.

C1 helps pupils.

P: C1 how do you do

C1:   Sorry?

P: How do you do question six?

C1:   How might you use a pair of dice to select one of the two choices? What could you do with dice that would give you like two different types of answer?

P: [Inaudible].

C1:   Yeah. But you roll [inaudible]. So how could you look at the answers so that it [comes?] two different categories.

P: Below six above six.

C1:   [**Unclear interaction**]

P:

C1:   You've got to do six as well in one of those wouldn't you. You can't say above or below. Six or below or above six OK. That will do so put that down.

C1:   You roll the dice you take one away from the total.

P: All right.

C1:   Yeah. So if you roll an eight eh you choose [seven bar seven] [unclear] yeah you

        repeat that all the way through the bars until you select.

C1:   Why aren't you even on the website? Why have you got three dice?

P: Because I'm making an [inaudible] shape.

C1:   That's not what you're here to do all right?

P: All right.

C1:   [Inaudible] to do and you've had twenty minutes to do it.

C1:   They're the ends of like phrases of music.

C1:   Nobody should be out of their places.

Pupils discuss work and continue with task including throwing dice.

C1:   No you select them yourself by rolling the dice. Roll the dice subtract one. Click it

        it changes every time you click it the numbers go up so if you roll a one and a five

        that's a score of six take one away from that you get five all right so bar one needs

        to be [inaudible] five so if you just click on it.

Tape stopped.

Tape re-started.

C1:   Have you heard yours P9?

P9:   No.

C1:   You couldn't hear it? I thought you said you could hear music earlier.

        Did you play did you click on em

        On there.

        Carry on sorry.

C1:   I thought we'd established that that no one can hear anything.

Pupils throwing dice as part of the task.

C1:   Right I'm coming round to collect in the dice now because we're going to have to finish in a couple of minutes em sorry this hasn't worked the way it's intended.

P: What should we do with the

C1:   Keep hold of it until next time what I'll probably do is show you how it should work on my computer upstairs.

C1:   Yeah well it's not actually it's times ten to the power of fourteen which means you actually have to multiply it by fourteen ten ten multiplied by itself fourteen times.

        You're going to have to log off.

P: C1 do we log off now?

C1 addresses all pupils.

C1:   Right can you all log off now please. Now keep hold of your worksheets and eh hopefully next lesson I'll be able to show you how it should have worked on my computer upstairs. OK. You can fill in the rest of them then. Can I remind you that you took the other worksheets home with you to finish them off and they need to be finished by next lesson. Right the word search and the cryptogram and things like that.

Pupil interaction on personal microphone set to conference mode during second part of lesson. Quality of audio recording compromised. Following excerpts heard but not in continuous passages.

P: How did you get that?

P: Oh you have to [inaudible]

P: What do I do here?

P: Oh you can't do that that's [inaudible] you just have to click there.

P: So you can't do it all?

P: No cos it's not here.

P: We're supposed to play that although we can't hear it we've got to play it. C1
why do we have to talk properly?

P: Em on what estimation [inaudible]

P: I don't know where that is I can't get to it.

P: What did you do here?

P: I put down more than a hundred trillion and it says [inaudible]

P: More than a hundred trillion.

P: Click click on more than a hundred trillion and then the one [inaudible] next.

P: This is solid this is.

P: Go to next there.

P: What's the answer to

P: Did you fill in that there?

P: No you've got to [inaudible] here

P: What did you put there? What did you put there?

C1: Right I'm coming round to collect in the dice now because we're going to have to
finish in a couple of minutes em sorry this hasn't worked the way it's intended.

Approximate percentage inaudible/unclear words 0.58%

Gwers 2 Athro C2 Blwyddyn 10 Amser 2.35pm

Lesson 2 Teacher C2 Year 10 Time 2.35pm

C2:   Reit setlwch lawr plis eh reit felly just mynd drost gwaith ddoe yn sydyn sdim

        rhaid i chi gopio lawr P5 falle fasa fo'n syniad i chdi copio fo lawr iawn OK. Eh

        so just ehangu dau braced OK. OK. Felly ermwyn ehangu dau braced

P: Da ni'n copio hwn lawr?

C2:   Na. Rhaid defnyddio reit be da ni'n defnyddio os gwelwch yn dda. Pa techneg?

P: Camo.

C2:   Camo reit. Camo OK. Be mae c yn sefyll am os gwelwch yn dda?

Ps: Cyntaf. Allanol.

C2:   Allanol.

P: Mewnol.

Ps: Olaf.

C2:   Reit da ni'n gwybod y geiriau so sut da ni'n defnyddio nhw iawn. So mae dau

        braced os oes genai dydwn ni m tynnu dau m plus chwech OK reit cyntaf pa un

        dy'r un gyntaf? P1?

P1:   m lluosi efo m.

C2:   m lluosi efo m OK sef y dau yna iawn so mae da ni c sef m lluosi efo m sy'n

        rhoid be i mi os gwelwch yn dda.

P: m sgwar.

C2:   m sgwar. Yr allanol pa un ydy'r un allanol

P: m chwech.

C2:   m lluosi efo chwech. So m lluosi gyda chwech sy'n rhoid chwech m. OK mewnol

        be ydy'r mewnol os gwelwch yn dda?

P: Dau ac m.

C2:   Dim y dau ac m.

P3:   Minus dau.

C2:   Minus dau ac m sy'n rhoid minus dau m. A yr olaf be sy gen ni ar ôl be da ni heb

        wneud minus dau a minus chwech so mae minus dau lluosi gyda plus chwech sori

        yeah sy'n rhoid be i mi os gwelwch yn dda?

P: Minus un deg dau.

C2:   Un deg dau.Wedyn cyfuno nhw ni'n cael m sgwar plus chwech m tynnu dau m

        tynnu un deg dau so m sgwar plus

P: Pedwar m tynnu un deg dau.

C2:   Reit a na fo iawn. P5 OK ai trwyddo fo gyda ti gweld sut mae'n mynd. So os

        allwch chi cario mlaen lle oeddech chi di cyrraedd wers diwethaf.

P: Tri d.

P: Tri e.

C2:   Tri e reit. Tri d. P8 lle wyt ti di cyrraedd sori?

P8:   Tri ch

C2:   Tri ch reit. Reit em shsh reit os dwi'n gofyn i chi wnai ofyn i chi weithio rhyw

        bum munud wedyn ai dros atebion gyntaf cwestiwn tri iawn wedyn gewch chi

        fynd i gwestiwn pedwar OK. Oh *actually* just isio tynnu sylw chi'n gyntaf at

        rhywbeth iawn so gai os allwch chi troi at ail tudalen y taflen os gwelwch yn dda

        tra dwi'n cofio reit. Chi'n sylwi ar cwestiwn saith yeah mae gen chi triongl ongl

sgwar ond dy'r eh *measurements* ddim yna reit mesuriadau ddim yna iawn so os allwch chi sgwennu oh mae b mae a b iawn yn x plus 1 reit allwch chi sgwennu o mewn so a b ydy x plus un ac mae a c yn x plus pedwar iawn. Ac ar y tudalen olaf

Ps: a b *equals x* plus un.

P3:   Hynna yn cwestiwn saith C2.

C2:   Cwestiwn saith a b yn x plus un ac a c yn x plus pedwar iawn OK. Ac ar y tudalen olaf mae gen chi'r dau petryal yna petryal a petryal ie? Ar hyd y top mae o yn un deg dau ac ar hyd yr ochr mae o yn saith iawn.

P: Centimeter. Dyna fo?

C2:   Ie. OK.

P: Mawr ie neu yr un bach yr un mawr.

C2:   Saith yr un mawr OK a da chi'n gorfod ffeindio'r arwynebedd yr tu mewn OK. Reit pawb yn hapus i weithio wnai rhoid pum munud i chi wneud cwestiwn tri rhan o fo *anyway* a wedyn awn ni dros cwpl o atebion OK. Pawb yn hapus?

Ps: Yeah.

C2:   P5 elli di wneud y chwech gyntaf yn cwestiwn dau gyntaf wedyn wneud cwestiwn tri OK iawn? P5.

C2 helps individual pupils.

C2:   Na ti dwi di wneud newidiadau ar rhein sgwenna nhw lawr. Cwestiwn saith [inaudible].

Pupils work almost silently.

C2:   P5 sbia allanol ydy'r dau ar y tu allan OK dau ar y tu allan yeah ti'n weld o

allanol so y dau ar y tu allan da chi'n galw'n cyntaf allanol mewnol olaf so y dau

term gyntaf sy'n mynd gyntaf yeah wedyn y dau term ar y tu allan iawn

P5:   Mm

C2:   Wedyn y dau term ar y tu mewn

P5:   Iawn.

C2:   Iawn so a ydy o OK?

P5:   a OK.

C2:   OK so mae'n reit a OK. Iawn.

C2 addresses all.

C2:   Cofiwch os dych em rhan sgwar chi yn negyddol yeah just dydwch triwch rhoid

rhif positif gyntaf bob tro os da chi'n gallu ie so dwi ddim eisiau gweld pethau fel

minus un deg pump beth bynnag sgwar iawn.

P3:   Eh deud hynna eto.

C2:   Eh wel er enghraifft os fasa hwn yn minus m sgwar wel fasa fo'n mynd pedwar m

tynnu m sgwar tynnu un deg dau.

P3:   Iawn.

C2:   Ie dyna be sy genai rhowch yr un positif gyntaf wedyn y rhai negatif just i wneud

o edrych yn daclusach OK *good.*

C2 helps individuals.

P4:   C2 ydy hynna yn iawn? Tynnu un a cos mae hwnna'n un a fana ond diom plus

C2:   Da iawn P4 da iawn.

P4:   Just tynnu hwnna.

C2:   Yeah minus un deg dau yeah good well done.

C2:   Da iawn. Caria mlaen.

        Ti'n gorffen OK.

C2:   P5 gai awgrymu iawn ti di wneud o'n *wrong* oedd ti eisiau *equals* mewn. Fi di

        rhoi llinell OK ond ti'n rhoid *equals* mewn achos ti ddim yn mynd yn *confused* so

        fel bod ti ddim yn drysu efo *minuses* yeah OK.   **[Best possible]**

P5:   Yeah.

C2:   Iawn.

        Gai awgrymu P3

P3:   Bod fi'n?

C2:   na bod ti'n just yn em ti'm yn wneud hwn i gyd tynnu nhw allan yeah so just

        eisiau mynd c *equals equals* em tri g sgwar beth bynnag iawn OK.

P3:   Oh dim rhaid i ni sgwennu o?

C2:   Na na na na achos mae hwnna'n blêr dydy yeah?

P1 shsh.

        C2 addresses all pupils

C2:   Reit gai just fynd dros cwpl o atebion yn cwestiwn tri a dros y chwech cyntaf just

        i wneud yn siwr ni'n wneud nhw'n iawn OK so tri a OK. Em OK tri a a di

        sgwario tynnu a neu un a tynnu un deg dau yeah?

P3:   Tynnu un a?

C2:   Un deg dau ia tynnu un a. Eh b b di sgwario tynnu tri b tynnu deg. C c di sgwario

        plus tri c tynnu un deg wyth. Ch d di sgwario plus saith d tynnu wyth. D e di

sgwario tynnu un e tynnu dau ddeg yeah. Ac dd f di sgwario eh plus un f tynnu chwech iawn unrhyw problemau efo rheina?

P4: C2 ti'n wneud heina?

C2: Ddim yn lecio hein ond cael go os wyt ti eisio.

C2: Ai dros hein heddiw *actually* ai dros nes ymlaen yn y wers yeah iawn falle ddim nhw gyd falle tua tri ohonyn nhw OK. *Come on* P4.

P1.

P1: [Inaudible]

C2: Gai weld.

Fan hyn. Tric i ti reit efo just efo rhai bs ma y *singular* iawn fatha unigol ie os oes gen ti dau b diom yn gweithio iawn ond just ar gyfer bs OK neu xs mae'n gweithio yr un ffordd a pluses OK. So efo minuses dau minus yn gweithio union yr un ffordd a plus so er enghraifft os allai [inaudible] pump fana em so wnai trio chwilio am enghraifft sy'n debyg ond allai ddim yeah ond be o'n i isio dweud ydy reit os os mae'n plus sa fo'n a sgwar plus pump a plus chwech. So yeah mae'n iawn so sa hwnna'n a plus dau a plus tri iawn so mae'n gweithio yn yr un ffordd just mae minus fan hyn so *confusio* [inaudible]

P: Dwi wedi *confusio.*

C2: OK just gwna just gwna fo fel o'r blaen. Gyda llaw efo *minuses* hefyd iawn mae heina bob tro minus mae heina bob tro'n plus OK iawn.

P: Diolch.

C2: Pedwar m tynnu dau m be di pedwar m tynnu dau m?

P: Dau m.

C2:   Plus dau m tynnu wyth iawn.

P3:   Be [Audible] dwi'n wneud. Achos bod

C2:   Ti'n wneud f.

P3:   Ie.   **[Mixed responses from pupils]**

C2:   Wyth lluosi efo dau i yeah yn wneud un deg chwech i. Pedwar lluosi pedwar i

        lluosi efo minus pedwar yn wneud minus un deg chwech so mae hwnna'n rhoi

        dim i ti mae'n iawn mae'n iawn gen ti.

P3:   Yn lle?

        Cos mae hi di cael chwech dwi di cael wyth.

C2:   Mae hi di wneud o'n wrong P3. Paid â cymryd yn ganiataol bod hi yn wneud o'n

        iawn bob tro OK.

P3:   Felly tynnu'r dim?

C2:   Just just eh tynna tri deg dau yeah anwybydda os dion dim diom werth rhoid

        mewn nady. Os ydy o'n dim i mae o dim i ti ddim yn rhoid fo mewn.

P: C2 so yn f ddim yn gorfod cyfri a.

C2:   Wel mae o'n canslo ei hun allan achos so ti just rhoid wyth i sgwario tynnu tri deg

        dau dwyt. Achos mae dim i yr un peth â dim dydy a tim yn dweud un plus dim

        ti'n just yn deud un yeah.

P: OK.

        Pupils working silently

C2:   Em be o'n i'n dweud trio rhoid rhif positif gyntaf yeah minus dau ddeg naw m

        minus un deg pump m sgwar OK so just wneud o bach taclusach yeah.

C2:   P5 ti'n iawn sut ti'n ffeindio fo OK? Ti di wneud y chwech cyntaf eto?

P5:   Dwi ar y [inaudible].

C2:   OK. Cofio ti'n mynd ymlaen i cwestiwn tri ar ôl gorffen yr un yna iawn. Diom

        bwys bod ti'n wneud [inaudible]

P5:   Dwi'n gorfod wneud pob un?

C2:   Na. Em gai awgrymu bod ti'n wneud y chwech cyntaf chwech gyntaf iawn.

P5:   Oh reit.

C2:   Chwech gyntaf tri hefyd OK iawn achos dwi'n meddwl byddi di di cyrraedd yr un

        lle a pawb arall wedyn OK

P5:   Dwi'n gorfod cario ymlaen â cwestiwn dau b?

C2:   Oh na just gwna f rwan yeah unwaith ti di gorffen f reit gei di wneud a b c d dd

        reit tri a wedyn dos i cwestiwn pedwar a gwna hwna yn lawn OK.

C2:   Iawn P4?

P3:   Pedwar yn gwahanol i unrhyw rhai arall.

C2:   Dau minus.

P: Ydy hynny yn iawn?

P3:   Lluosi a'u gilydd mae nhw'n wneud plus yeah?

C2:   Rhifau negatif eto P2. Minus tri minus dau?

P2:   Minus tri minus dau be?

C2:   Be di minus tri tynnu dau?

        Dwi ar llawr minus tri dwi'n mynd i lawr dau llawr so pa llawr faswn i ar?

P2:   Minus.

C2:   Minus pump.

P2:   Yeah.

C2:   Reit iawn so cofi reit

P3:   Sut ti di cael? Dwi di cael dau minus.

C2:   Ie dyna ti fod i

P3:   Tri minus tri a tynnu

C2:   Dau a a mae'n rhoid

P: minus pump.

C2:   Na ti na minus pump achos meddylia amdano fo iawn. Cofiwch meddwl am

        rhifau negatif fel fatha

P: Ydy o fod adio yn lle fel *kind of* yn lle tynnu?

C2:   Ie ond just bod gen ti negatif os oes gen ti minus tri minus dau mae'r un peth â tri

        plus dau so gen ti minus pump.

P: OK.

C2:   *Fine* ond dyna be ti isio deud wrtha i ie?

P: Ie.

C2:   *Sort of thing.* Dwi'n gwybod be ti'n trio deud ond so os fasa gen ti minus tri a

        minus dau a mae nhw'n mynd i minus pump dydy achos mae o fel wyt ti ar llawr

        minus tri a ti mynd lawr dau llawr fasa ti ar llawr minus pump basat yeah?

        P4:

P4:   Dwi ar honna.

C2:   So gen ti un deg chwech i

P4:   Ie un deg chwech undeg chwech da ni just rhoi i lawr neu da ni'n rhoid dim byd

        lawr?

C2:   So be ti'n feddwl os oes genai un deg chwech afal a dwi'n tynnu un deg chwech

        afal sawl afal sydd genai?

P4:   Dim.

C2:   Dim so os oes genai un deg chwech

P4:   rhoi dim lawr neu?

C2:   Na mae dim i yr un peth â dim dydy. Ti ddim yn cymryd o mewn i ystyried

        nagwyt ti ddim yn sgwennu fo.

        P ti'n iawn? [Inaudible] *Negative numbers* just checkio.

        Cywir gen ti marcio nhw beth bynnag. Ti isio just ticio nhw yn gywir.

        Interruption.

C2 addresses all.

C2:   Reit gai ofyn fod chi'n dechrau ar cwestiwn pedwar os da chi heb cyrraedd

        cwestiwn pedwar eto arwahan i P5 OK reit. So just gorffen y cwestiwn shsh

        gorffen y cwestiwn da chi'n wneud dechrau ar cwestiwn pedwar iawn.

        [Unclear] to individual pupil.

C2:   Na mae heina yn cymysgedd

        [Inaudible] Negative positives positive negatives. Ie go on.

P: Em di hyn yn gywir fel?

C2:   Ydy mae'n gywir.

        C2 addresses all

C2:   Reit efo rhai bracedi lle mae dau negatif ynddyn nhw yeah mae term efo llythyren

        yn unig yeah bydd hwnna yn fel arfer yn em negyddol a fydd y rhif cyfan fel arfer

        yn positif. Mae na cwpl o cwestiynau nes ymlaen yn yr ymarfer *though* lle mae o

yn newid dwi meddwl o f ymlaen reit bydd hynna ddim yn wir iawn o f ymlaen

dy'r rheol yna ddim yn wir. Ond os oes gen chi'r dau llythyren ar dechrau'r

braced reit bob tro dyna ydy'r rheol bydd y term unigol yn negatif a'r llall yn

positif.

P: Cwestiwn pump just yn cymysg o bopeth?

C2:   Cymysg o bopeth ie.

C2:   *Well done.*

        A hefyd oh yeah sori *bad news* ond em trio cael saith i tynnu iawn [inaudible]

C2:   Na *whole lot whole lot* cwestiwn pedwar os gwelwch yn dda. Reit i gyd ohonyn

        nhw. Iawn P5

P5:   Yeah

C2:   OK.

        Pupils working silently.

P3:   C2.

C2:   P3.

P3:   Ydy chi'n gallu wneud hwnna'n fyrrach ydy chi'n gallu wneud hwnna?

C2:   Mae hwnna i fod yn pedwar i dydy.

P3:   Ydy?

C2:   Yeah i ydy o.

        Achos dyna ydio fo bob tro bydd gen ti un term sgwar gen ti un term rhifol rhif

        cyfan a wedyn bydd gen dau efo llythyren iawn a heina rhaid i ti watcho os oes

        gen ti dau llythyren yna wel ti'n gwybod bod ti'n *wrong* wedyn dwyt ie ti angen

        edrych yn ôl wedyn OK.

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C2: Minus tri a tynnu dau a so os oes gen ti minus tri tynnu dau mae'n wneud minus pump dydy. So mae gen ti minus tri a tynnu dau a yn wneud minus pump a iawn.

P3: C2 dy hwnna yn minus tri n.

C2: Be di minus n lluosi efo minus n

P3: Dau.

C2: Ie ond be di minus n lluosi efo minus n?

P3: [Inaudible]

C2: Be di n lluosi efo n

P3: n sgwar.

C2: Reit so felly be dy

P3: Yeah OK

C2: n sgwar na ti.

C2 Addresses all the pupils.

C2: Reit gai just fynd dros em rhai atebion cwestiwn pedwar iawn i gael marcio os chi yn gywir just fel dwi'n wneud yn siwr chi di

P3: O beth?

C2: Pedwar eh pedwar a ie reit chwech cyntaf pedwar a yn sydyn. Em a di sgwario tynnu pump a P6. So a di sgwario tynnu pump a plus chwech. B b di sgwario tynnu pump b plus pedwar. C c di sgwario tynnu un deg un c plus dau ddeg wyth.

P: C2 ydy hynny fod fana.   **[unclear].**

C2: Yndy. Ch d di sgwario tynnu naw d plus un deg wyth. D e di sgwario tynnu naw e plus wyth a dd ydy f di sgwario tynnu un deg un f plus dau ddeg pedwar iawn. Unrhyw problemau? Na? Iawn.

C2: P1 tro'r tudalen plis.

P1: Na dwi just isio hwn OK.

P: Diom yn [maint?] yna ydio?

C2: Nady. Mae gen ti dau minus yn wneud plus dwyt.

C2: Na ti'n cadw ymlaen achos mae heina yn mynd yn fwy anodd mae gen ti pethau

fatha pedwar g ac yn y blaen iawn.

P3: Be di pump just?

C2: Cymysgfa. Cymysgfa.

P: Wneud nhw gyd?

C2: Ddim yn ddifyr iawn ond well wneud o. Ti'n gweld hein yn dy gwsg heno.

Sut ti'n ymdopi heb [inaudible]?

P7: Mm?

C2: Sut ti'n ymdopi?

P7: [Inaudible].

C2: Iawn P5?

P5: Ddim yn gwybod sut mae wneud hwn.

C2: Be di minus pump lluosi efo pedwar.

P5: Minus dau ddeg.

C2: Na ti.

C2: Ti di gorffen cwestiwn pump eto?

Ti'n well efo cwestiwn chwech so mae a fana yeah b yn fana so [inaudible]

P: [Inaudible].

C2:   c plus un c plus un yeah dau di sgwario dau lluosi efo dau de so os oes gen ti c plus un di sgwario mae gen ti c plus un c plus un. OK.

P: OK.

C2:   Iawn.

C2 Addresses all.

C2:   Reit gai sylw chi'n sydyn plis. Reit em mae camgymeriad ar cwestiwn saith [unclear] mewn munud iawn. Em reit gwaith cartref heno ydy cwestiwn chwech reit a cwestiwn saith iawn *hang on* cyn bod chi'n cyn bod chi'n rhoi o'r ffordd dwi isio wneud nodiadau gyntaf iawn. Fel bod chi'n deall reit os oes genai c plus un wedi sgwario iawn hyn sy'n digwydd os

P3:   Sgwennu hwn lawr?

C2:   Yeah os chi isio

P3:   Ar y papur?

C2:   Mae o fyny i chi i chi. Os oes genai dau di sgwario be dwi'n wneud? Be dwi'n wneud?

P: Dau lluosi efo dau.

C2:   Dau lluosi efo dau. So os oes genai c plus un di sgwario be dwi'n wneud P1?

P1:   c plus un wedi sgwario *equals* c plus un

C2:   Dim byd di sgwario

P1:   a wedyn braced arall.

C2:   just c plus un c plus un OK dyna be mae'n meddwl wrth sgwario heddiw iawn. Cwestiwn saith dwi isio chi wneud hefyd iawn ond mae b c sgwar yn dau x di sgwario plus plus deg x plus dim pump sori plus un deg saith.

P3:   Beth ydy o sori? Be ydy o?

C2:   Cwestiwn saith b c sgwar ydy hynna iawn dau x sgwar plus deg x so gyda hwnna chi'n gorfod defnyddio Theorem Pythagoras iawn OK. So Theorem Pythagoras ydy c sgwar *equals* b sgwar plus a sgwar sori plus b sgwar iawn cofio hynny OK. Wedyn gyd da chi'n wneud wedyn ydy rhoid gwerthoedd yn lle a ac yn lle b iawn a gweithio allan iawn. So os da chi'n gallu wneud hynna i fi erbyn dydd Mawrth baswn yn ddiolchgar iawn. Sgwennu o lawr.

P: b c sgwar

C2:   b c sgwar equals dau x plus deg x plus un deg saith. OK gai y cadeiriau gyd ar ben y byrddau os gwelwch yn dda.

Approximate percentage inaudible/unclear words 0.51%

Lesson 2 Teacher C3 Year 10 Time 10am

C3:   Right are we ready let's get going. Delighted to see so many scientific calculators

out and ready. Well we better make sure we use them today otherwise we'll be

behind schedule. Where's P5? There he is. Where have you been?

OK thank you thank you. Eh right so eh we've we've had a little chance to think a

second time around about what standard form numbers look like and we've had a

little beginning to think about doing calculations with them em em do we need to

write it down a little more formally than we I don't think you got to writing down

anything about the calculations yesterday did you.

P: No

C3:   So we better just have a little think about that. Eh just before you start your

writing then let's just try and wake up a little and think about what they look like

em P23 how do you write that in standard form this one here.

P23:   Five o three o eh five o three o equals five o three yeah five o three

C3:   Five o three

P23:   Times ten to the power four.

C3:   Nearly one little bit missing P23.

P23:   Five point zero three.

C3:   Point well done so we've got a bit between one and ten times ten and always ten

and a power which tell us how many things we've jumped and then P10 had

better do this one for us what about this one P10? What would that be?

P10:   Em five point zero three times minus eh power of minus four.

C3:   Times

P10:   Ten to the power of minus four.

C3:   Ten to the power of minus four is it again

P10:   Yeah.

C3:   One two three four good well done. So we've got these standard form numbers a bit between one and ten times always ten and a power negative power for s tiny numbers positive power for big numbers the number of the power just being the number of jumps you've got with your decimal point OK and then we started to have look at these calculations didn't we and we did I can't remember what the numbers I chose were but they were something along these kind of lines. Now I need you to look at these things two different ways OK. Firstly I need you to look at it in a in terms of relatively straight forward numbers eh in a non calculator fashion because it may well come up in a non calculator paper. So you've got to be able to cope with it in that way when the numbers are fairly straight forward but then I need to see how to do these types of calculations if you've got a calculator to do it with as well. And we've got to have to learn today about how to use our calculator effectively with standard form numbers OK. So kind of things we were looking at yesterday we stuck to the non calculator type of things yesterday and we might have been doing oh I can't remember what they were things like eh eight times ten to the power of seven and then multiplying this by em seven times ten to the power of minus two and thinking about how we might work out an answer to something like that and then make sure our answer was in standard form as well. So a multiplication of two standard form numbers and then

we've got to think about division of two standard form numbers as well maybe eh two times ten to the power of eight divided by eight times ten to the power of two or something multiplying standard form numbers dividing standard form numbers OK. And eh I think we were fairly it seemed fairly straight forward what you've got to do you just multiply the number bits together and then you multiply the power of ten bits together and then try and make sure you've got your answer right. P16 do you want to have a go at this one? First one.

P16:   Yeah go on.

C3:   Do your numbers first.

P16:   Eh eight times ten to the power

C3:   Just the number bit kind of thing you know the easy bits if you like the eight that's how we're going to do it we're going to do it as eight times seven and then we're going to do ten to the power of seven times ten to the power of minus two we're going to work out those two things individually.

P16:   Em fifty six

C3:   Eight sevens fifty six. Glad you know your seven times table so well P16 with the help of a calculator. And then what how are you going to deal with your tens and powers of ten bits?

P16:   Em I don't know.

Line 64   C3:   OK this [inaudible] relies on you remembering your rules about powers and how you... how you simplify those kind of things doesn't it

P: Is it five?

C3:   It is five yeah. What did you do to get five?

P: Seven plus minus two goes down.

C3:   Good. If you're multiplying two things like this together... same big number and just different power numbers... if you're multiplying these things together you've got to add your powers together... this is seven plus minus two... that's going to give us five so it must be fifty six times ten to the five. What's wrong with it at the moment P16 can't leave it an answer like that can I? Why not?

P16:   Em oh five point six.

C3:   Good OK this isn't standard form cos I've got a number bigger than ten here so I've got to change it to five point six and

P16:   Times to ten to the power

C3:   Ten to the power of something.

P: *Chwech.*   [Away from the immediate floor of this interaction]

P16:   I don't know.

C3:   Don't know somebody help him out.

P: *Chwech.*

C3:   Why?

P: Cos you've gone back one decimal place so you've got like gone up in the power thing it's just like six.

C3:   Right it's... yeah.

Line 87   P: Is it four?

C3:   No. I've got to go another I've got to hop my decimal point another place haven't I from a big number to a smaller got to keep hopping more and more places one

more place than I've hopped so far so far I've hopped five places got to hop another one that's going to go up to six all right with that P16?

P16:   Yeah.

C3:   That last stage is definitely the bit that's going to get the most confusing isn't it thinking about when you go up with the number and when you go down with the number what if it's a negative number to begin with are you still going up or down and are you going to the right place when you've done it that's the difficult bit really we'll just have a little practice see how you get on with it then. And then the division bit. P15 do you want to do this division bit?

P15:   Em

C3:   So I'm going to do it again. I'm going to the number bits

P15:   Eh

C3:   Hang on and then I'm going to do the powers of ten bits and then I'm going to hope that my answer is in standard form or change it if it's not.

P15:   OK.

C3:   Go on then.

P15:   Two divided by eight is nought point one two five.

C3:   Nearly one divided by eight would be nought point one two five. Go on go on you should be able to do it in your head really but just for now.

P15:   Nought point two five

C3:   Yeah it's a quarter isn't it.

P15:   Yeah.

C3:   Yeah so nought point two five for the first bit what about this bit P15 how you going to cope with those powers of ten?

P15:   Times ten

C3:   Yeah.

P15:   to the power of do I add them together?

C3:   Well we added them together when we were multiplying our powers of ten when we were multiplying these things together didn't we cos we did seven plus minus two equals five here I'm dividing so what do you think this time?

P15:   Take them away.

C3:   Take them away so?

P15:   Six

C3:   Six. Nought point two five times ten to the power of six.

P: C3 why is it times them when we're doing divide?

C3:   Em it's it's these times' here it's not that divide bit there it's just those times bits and they will always be a times there never turn into a divide those bits. What's wrong with it so far P15 haven't quite finished yet have we what are the rules about standard form numbers? What's the first bit got to be?

P15:   Em between

C3:   Yeah between

P15:   one and

C3:   one and ten yeah? I can't leave it as nought point two five that's too small what shall we change it to?

P15:   Two point five.

C3: Good well done. Right the effect of that jump from fifty six P15 to five point six was to move the power up by one wasn't it. What's the effect of this jump from a small number to a bigger number rather than from a bigger number to a small number

P15: Take it down.

C3: Take it down by

P15: Eh one.

C3: One. So what do you want for your end bit here?

P15: Times ten to the power of five.

C3: Excellent that's brilliant well done P15.

P: C3 if if it was a [inaudible] five hundred and sixty then you'd have to take the power down by two   [Not expressed clearly]

C3: Yes you would.

P: [inaudible]

C3: You'd have to take the power up by two actually if it started at five hundred and sixty yeah take it up by raise the power by two.

P: If it was C3 if it was fifty six times ten to the power minus five

C3: Yes.

P: And then you done five point six times ten to the power of minus four.

C3: It would yes well done.

P: C3 if the number is higher than ten you add and if the number is less than ten you take away.

C3: Yes you mean this bit here yes if it's less than one you take away yes if it's bigger than ten you add OK all right OK just have a little practice on these I want I want to be fairly quick with this cos obviously we've got to get on to the calculator business haven't we so I'd like just to do a few for you to see if you can do it for yourselves just for five minutes or so not long and then we'll get on to the calculator stuff. So for the time being I'm going to try and pick numbers which you should be able to do without a calculator. I'd prefer it if you at least tried to do it without a calculator as well just to make sure if you're really worried about it then I'm do the you know two divide by eight bit or something like that.

P23: C3 will our answers be that long?

C3: Eh if you can do some of those stages in your head confidently and accurately P23 I don't mind you missing some of them out em but until your absolutely secure in it I think they should be probably that long yeah? Eh yes right here we are let's try some.

P: C3

C3: Hello.

P: Em can I borrow a pen please?

C3: Oh P5

P: C3 you know em on the second one where it was two you know on the second one where it was two times you know the ten to the power of eight

C3: Yeah

P: and divide by ten to the power of two

C3: Yeah

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P: Well wouldn't you divide eight by two?

C3:   No

P: The top power

C3:   Yeah cos they're power numbers when you're dividing two things with big numbers the same and diff and some power numbers with them the rule about the powers is that you take your powers away it's like doing five to the power of eight divided by five to the power of two gives you five to the power of six same kind of rule as that OK?

        Em how many more three times' and three divisions shall we?

P: C3 I don't understand how

C3:   The nought point two five bit?

P: Yeah

C3:   Can you see how I'm splitting the sums up so first of all?

P: Yeah

C3:   So from two

P: Oh yeah no I see

C3:   So two divided by that eight is giving me the nought point two five

P: And then

C3:   And then that bit is giving me that bit's giving me the ten to the power six bit.

P: Ah right

C3:   Yeah?

P: Yeah.

C3:   Does that make sense?

P: Yeah.

P: Forty

C3:   No you've multiplied your power numbers together there haven't you

C3:   Five eights are forty

P: Aha

C3:   Yeah that's not what we were doing here was it remember ten to the power seven times ten to power of minus two ten to the power of five.

P: C3 [inaudible]

C3:   No afraid not it's minus three plus minus two.

P: Other way around isn't it [inaudible]

C3:   Starting at minus three

P: Yeah.

C3:   Going up by cos you're adding minus two.

Pupils continue working.

P: C3

C3:   Hello

P: May I trouble you to have some help please?

C3:   Yeah all right then

P: Do you know with [inaudible] do you add them.

C3:   These bits you're just doing the straight forward calculation eight sevens fifty six two divided by eight is nought point two five five sixes are thirty that's correct.

P: But with these do I add or?

C3:   Those ones the power numbers you add together that's right.

P: Oh right so I've done that right?

C3:   You've done that perfectly right.

       Hang on let me just write one more.

P: C3.

C3:   Hang on.

P: [Inaudible]

C3:   Is it perfect

C3;   Oh you've copied down that bit wrong that's all but otherwise yes you would

       have done it correctly.

P: Doing this one now I don't know what to do.

C3:   Right so this is a big number that you want to make smaller so that means

P: [Inaudible]

C3:   Yeah that's going that way your powers got to up by one hasn't it but it's starting

       negative so it's getting less negative when it goes up by one.

Ps: Minus six minus six

C3:   No that's more negative

P: [Inaudible]

C3:   Yeah minus four.

P: [Inaudible]

C3:   Why?

P: Because when you add

C3: That's OK power number can be as much as it wants it's only this bit that you're not allowed to go more than ten which it has at the moment but you're going to fix it in a minute.

P: [Inaudible]

C3: No they can be as big or as small as you want. OK be there in just a sec P10.

P: Is that right? P8 told me I did it wrong.

C3: No it's OK yes that's perfect that first one eh twelve point four times ten to the minus five yeah that's good.

P: [Inaudible] take away one.

C3: What do you mean by take away one.

P: You take away a power.

C3: So what's your answer going to be? Right that's actually adding a power but yes you've done the right thing.

P: Oh yeah

C3: You've got to the you've got to the right place

P: Oh yeah minus six

C3: You're going up from

No your minus four was right

P: You said it was going up minus

C3: Yes you're adding one to it aren't you

P: You add one to that one.

C3: Adding adding one to minus five takes you up to minus four doesn't it.

P: [Inaudible]

C3:   Yeah so your answer was correct what I was what I was trying to just make [inaudible] was not subtracting one from the power which is what you said it was it's actually adding one to the power but you got to that place so that's it well done.

P: [Inaudible]

C3:   Yes

P: I thought that was

C3:   So here you've added one to the power you've gone up from thirteen to fourteen here you've also added one to that it looks like it's go smaller but it hasn't so you've done it right.

P: Is minus four smaller is minus four smaller than minus five?

C3:   No it's bigger.

P: Is minus six?

C3:   No cos you want it to go oh you've done that one wrong.

P: Oh what.

C3:   You've gone from a big number

P: To a smaller?

C3:   Yeah so you're going another one place aren't you you're hopping.

P: [Inaudible]

C3:   Yeah so do your five times six bit

P: You do five times six thirty

C3:   Yeah good

P: So equals

C3:   And then you're doing your ten times five times your ten sorry ten to the power of five times ten to the power of eight.

P: So it's ten times five

C3:   Ten to the power of five

P: Yeah well it [inaudible]

C3:   No ten to the power of five means ten times ten times ten times ten times ten which is a hundred thousand.

P: Oh oh yeah ten times ten is a hundred times ten is a thousand times ten is ten thousand

P: C3 on number two yeah

C3:   Yeah good well done that's right.

P: You know after that do I add the one or take one?

C3:   Ah Ok what did you do on this one? That one you added one there didn't you because you were going from a number bigger than ten to a number smaller than ten which is the same thing that you're doing here isn't it.

P: Add one.

C3:   So what's it going to be then if you add one to that?

P: Minus six.

C3:   No that would be taking away.

P: Oh right minus four.

C3:   Yeah cos you're going from [inaudible] you're going up right well done that's very good.

P: Ten to the power of eight would that be em

C3:   You really going to write out a long multiplication like that there's a much easier way of doing it P5. Much easier way of doing it.

P5:   How? In your head.

C3:   Ten to the power of five times ten to the power of eight is ten to the power of thirteen.

P5:   Now I've written out like yeah write out the answer

C3:   You write thirty times ten to the power of thirteen. You don't ever write this out it's a complete waste of time. Hang on a minute P nearly finished here.

P5:   I do for the but then I know what the answer is.

C3:   But then you realise it's not standard form yet because this thirty is not following the standard form rules.

P5:   No it's three [Inaudible]

C3:   Good

C3:   Are you tell are you really telling me that two divided by five is ten and you've used a calculator and eight point two divided by two is sixteen point four? Yeah we're dividing these ones yeah eight point two divided by two is going to be four point one isn't it not sixteen point four. Sorry nine divided by two is going to give you four point five.

C3:   No you would have to make it one times ten to the power of four yeah but it's wrong anyway. Right anybody finished

P: No I've only done that.

C3:   Anybody stuck [laughter]. What's up P15?

P15:   I can do them.

C3:   They take a lot of thinking about don't they no question about that.

P: C3

C3:   Hello.

P: I don't know how you do that one.

C3:   Why not?

P: [Inaudible]

C3:   Why? You think you've done it wrong.

P: I'm not sure which up or down have I done it right or?

C3:   It's you're always going up or down depending on what don't worry about whether it's negative or positive think about whether you're going up or down.

P: I don't und

C3:   Let's have a think look did you go up or down here?

P: Up

C3:   Right so from thirty to three going from a big number to a smaller number you went up. Yeah? Did you go up or down here?

P: Up

C3:   No you didn't minus five to minus six is down one step isn't it. Should you have gone up or down?

P: Up

C3:   You should have gone up so it should be minus four that's it confusing fourteen point seven to one point four seven should you go up or down?

Ps: Down. Up.

C3:   Up?

P: Up.

C3:   Yeah cos you're going from a big number to a small number. So have you gone up or down you've gone down there you should have gone up to minus fifteen yeah?

P: Yeah I get you.

C3:   Eighteen to one point eight should you go up or down?

P: Down.

C3:   Why?

P: [Inaudible]

C3:   Ah hang on a minute actually should it be eighteen at all nine divided by two ah look [inaudible] divide.

P: I got that.

C3:   Yeah yeah that should nine divide by two four point five and then there's nothing to do with that one is there cos it's already a standard form number that one.

P: Four point five times ten to the power of [inaudible]

C3:   That's right. You two finished?

P: Yes.

C3:   Shall we mark them then?

        You've copied the questions down wrong that's why you've finished sorry no that's the first three [inaudible] first three now the next three. This is fine I like that bit yeah that's fine [P] what are you worried about? Fourteen point seven I think just fourteen point seven not fourteen point seven seven isn't it? Cos seven

twos are fourteen seven point ones is point seven so fourteen point seven I think times ten to the power of four. Yeah that's fine.

C3:   [Inaudible] six you've got to divide as well haven't you.

P: [Inaudible]

C3:   No you do minus eleven take away six minus eleven take away six.

P: Minus five?

C3:   No. Start at minus eleven. Can you picture a number line? I have it vertically in my head do you have it horizontally? OK you have [inaudible] minus eleven there so your nought is up here is it? And you take away six your take away is going left isn't it.
         Minus eleven anyway so minus eleven down minus six. [P] have you finished? [Inaudible]. Are you waiting are you? Yeah I won't be a second.

P: You know where you put the point?

C3:   Yeah.

P: and then you change the power can you just check.

C3:   Yeah right that one I like and I like this. Em that one's gone down why's that one gone down these ones both went up didn't they thirteen up to fourteen minus five up to minus four. Why [inaudible] come down? Well that bit I like but I don't like that three there.

P: That's a four

C3:   No this is a four.

P: Oh that's a five.

C3:   Yes that should be a five. These ones you've multiplied these here haven't you. You should have divided. Here you should have divided as well and here and here. So you've got those [inaudible] wrong I'm afraid.

        Right.

P: But I can't [inaudible] five.

C3:   Why not?

P: I don't know.

C3:   What do you mean you don't know. Have you looked at the example? P14 don't waste my time come on.

Unclear interaction with a pupil

        Eh it's a two there actually on the board you've just copied it down wrong two times ten to the power of two not six all right?

C3 addresses all the pupils

C3:   Right let's have a quick look please we need to be moving along don't we. Let's have a quick check then. I don't want to go through all the detail P6 don't want to go through all the detail can we just have answers please. P2 what have you got for the first one?

P2:   Em I don't know I didn't do it.

C3:   Have you not done any?

P2:   No

C3:   Why not?

P2:   I couldn't do them.

C3:   Oh dear we need to spend a bit more time on this then don't we. OK.

P2:   I don't understand these ones is that a times or a divide.

C3:   You're going to have bare with me for a minute while I check these off then I'll come back to you all right. Eh P19 have you done the first one?

P19:   Yes.

C3:   What have you got final answer only please.

P19:   Two point five no no [inaudible] three

C3:   Shsh P12 and P11 books open marking please. Sorry P19.

P19:   Three times ten to the power of fourteen.

C3:   Good three times ten the power of fourteen. Some people I notice have got three point nought times ten to the power of fourteen either of them is fine I don't mind. P24 next one.

P24:   One point two four times ten to the power of minus seven.

C3:   Minus seven don't think so?

        Seems to me like you may just be guessing now. OK can you just go back one step through your answer. Hang on shshsh excuse me P19 need you quiet now for a minute.

C3:   What did you read it wrong to me?

P24:   Yes

C3:   OK so what should it be? One point two four times

P24:   Times ten to the power of minus seven.

C3:   That's what you said the first time round. Which one which one have you written?

P24:   Minus seven but I changed it from minus four.

C3:   Right OK Yes I don't know why you changed it.

P19:   Why have you marked mine right then when I've got [inaudible]?

C3:   Yes it's never going to go from minus five to minus seven is it two steps I mean you're only hopping one more place here aren't you and it's going up minus four please.

P19:   You marked mine right.

C3:   Well because you copied it down oh no you haven't copied it down wrong. I was only yeah I only looked at from there to there and from there to there is a correct step but this answer's wrong here that shouldn't have been a six so that's why I marked it right. So sorry P19 I shouldn't have marked that right.

Thank you come on. You ready P1 next one.

P1:   One point four seven times ten to the minus fifteen.

C3:   Don't like that afraid. Don't like the minus fifteen. What's wrong with minus fifteen?

Ps: [Inaudible]

C3:   No

P1:   You told us how to do it.

C3:   Mm

P1:   You told us how to do it you told us

C3:   From there to there is right. This bit's wrong

P1:   What bit?

C3:   That bit from there to there is wrong from there to there is correct.

P1:   Oh

C3: That's what you were asking me about how do you get from that number to that number and that's you've done that correctly but this bit from there to there you've done wrong.

C3 addresses all

C3: Come on. What should I have here I should have minus ten to the minus six times ten to the power of ten.

P12: Five power of five.

C3: Hang on hang on you've gone two steps there P12 listen to my question first please. What should I have ten to the power of minus six times ten to the power of ten should give me how much?

P: Four

C3: Ten to the power of four cos that's I'm sorry I'm going to stop doesn't matter you're not paying the slightest bit of attention you're not thinking about this at all I'm wasting my time at the moment makes me cross. I need you thinking about this. How many have you got right so far?

P: Em eh both of them.

C3: Excellent. P20?

P20: Both of them.

C3: P21.

P21: Both.

C3: OK doesn't mean you don't contribute though please. Ten to the power of minus six times ten to the power of ten that's going to give me ten to the power of four doesn't it P1. Minus six plus ten giving me four picture your number line starting

at minus six going up ten steps yeah. But then I've got to deal with the change from fourteen point seven to one point four I think you should have one point four seven here as well here really P1.

P1: I said

C3: Oh did you I missed I didn't here you say the seven. So what should we have at the end here? I've gone from fourteen point seven to one point four seven where's that going to take me to?

P: Five.

C3: Ten to the power of four to ten to the power of five isn't it it's going another one up one point four seven times ten to the power of five OK. What about the division these are much more difficult I think. P18 do you want to do the first one for me?

P18: Yeah.

C3: What have you got.

P18: Four point five times ten to the power of three.

C3: Good. Well done. There wasn't any amending to do with that bit was there the nine divided by two bit gave you something that was smaller than ten already and not smaller than one so we could leave that one no second stage on that one. Em yeah I think it was only that one that did in the end wasn't it. P17 what about number five?

P17: Four point one times ten to the power of minus seventeen.

C3:   Good so what we're checking up on there is making sure that we can go

        downward in our powers starting from a negative one and divided by a positive

        one that's going further down from minus eleven down another six steps P13?

P13:   Four times ten to the power of two.

C3:   Four times ten to the power of two. So what are we doing there? We're doing two

        divided by five is nought point four aren't we ten to the power of minus three

        divided by ten to the power of minus six that's ten cubed. And then we've got to

        go from a small number to a bigger one yeah four times ten to the power of two

        that looks about right to me OK? They're not easy those I don't think. They get

        pretty confusing when you get a whole load of different ones together like that.

        And again it comes down to one of those basic things doesn't it about your

        negative numbers which eh you know you've got to be confident with your

        positive and negative numbers you've got to know which way up and down

        you're going with positive and negative numbers when you're going up and when

        you're going down tricky.

        Right calculators at the ready please. So you need to be able to do these kind of

        things with a calculator as well. I would like you to be able to put a standard form

        number into the calculator and do the calculation with it. Some of some people

        are tempted to change from a stand think about what this really means think that

        this is really eh what is five hundred thousand really and then put it in as five

        hundred thousand but it's much more convenient if you can if you know how to

        use your calculator accurately to do it all in standard form and get the answer in

        standard form as well if you can. So for example this first one if I wanted to put

into the calculator the number five times ten to the power of five I would five you should be able to find somewhere on there an EXP button. Exp so if you put the number five in and then you press the exp button.

P: E X P

C3: E X P the button that says E X P on it just above your seven button yeah and then listen listen listen listen listen. Let's just start that process again shall we. Firstly can you find a button that says E X P on it?

Ps: Yeah

C3: Anybody not find a button says E X P on it?

No here found it. Anybody not found E X P button? You've not got yours. Right. Thank you P14.

C3 addresses all

C3: So to do this calculation on do you mind P19 please your holding us up. To do this calculation on your calculator rather than having to worry about your positive and negative numbers and all the rest of it you do this. Five E X P five it should on your calculator display now say five and then a dot and then a tiny little times ten and then an o five just above the times ten or something like that it depends on your calculator it might be a bit different. Let me have a look. Yours is a different type is it?

P: Yeah [inaudible]

C3: Yes that's fine yeah that's saying the right thing your going to need to learn carefully how to interpret things a bit [inaudible] yours says the same doesn't it

yeah that's right. You all right with yours five e five that's right that's correct are we all right with that five e five good.

C3 addresses all

C3:   All right thank you thank you. So that thing that you've got there at the moment five times ten o five or five e five depending on which one it says that's this first number and then we need to multiply by another standard form number so you just do times and then you go though putting another standard form number in six E X P eight.

P: Brackets?

C3:   No don't need to put brackets or anything

P: Equals

C3:   And then you just press equals. What does it say? Three times ten to the power fourteen we got it right hoorah. That's it.

P: E X P

C3:   Hang on what have you done with you five E X P five.

P: Five E X P five

C3:   Yeah then times

P: then oh right times

C3:   What was the next one six E X P eight.

         You didn't press the E X P button carefully enough and then equals.

         What's what P22? That's for doing things like seven to the power of four or something.

P: Five times ten then that

C3:   Yes good so it's easier to put it as standard form but it will still be correct yeah. All right is everybody OK with that has everybody succeeded in getting something that looks right. Right OK have you done the calculation? You've just got six times ten to the power of eight in there haven't you.

P: Oh

C3:   What about your five times ten to the power of five and then multiplying it by this.

P: Five times ten

C3:   No Five E X P five and then times six E X P eight.   [Pupil repeats]

P: I get it now.

C3:   So three times ten to the power of fourteen OK? Which is what we got.

C3:   All right every body OK with that.

C3:   A?

P: [Inaudible]

C3:   I'd rather you didn't. Yes there are other ways of doing it.

P: [Inaudible]

C3:   Well yeah but that's not that's not [inaudible] standard form then.

P: Ah.

C3:   Yes you could do it that way. I'd like you please to use your calculator now are you listening P20 just a couple of minutes. I'd like you to just to use your calculator now to make sure that I've done I've got all those right cos I did them all in *me ed.*

P: In your ed

C3:   Check please.

P: In your ed

C3:   Check your answers there do each one of those calculations should be able to do
        that in two minutes.

C3:   Good. No in standard form now. Do each calculation in standard form on your
        calculator. Thank you listen I'll just tell you now. P16 you listening? You're
        going to have to put in here some negative powers as well that's OK just use your
        plus minus button or your whatever yeah that button down at the bottom that says
        plus stroke minus on it. I'm not sure how it says it on other calculators but it will
        be there somewhere.

P: That one

C3:   Yeah on these Casio ones it's got a minus in brackets so use that so you just use
        that before the listen Oy Oy excuse me thank you so here your going to be doing
        something like three point one E X P minus two.

P15:   How do you put minus two in?

C3:   Use your plus minus button down at the bottom of the calculator P15.

P15:   That one?

C3:   Yep. Or if you've got one of the Casio calculators you need to be using the minus
        in brackets button in before the two.

P: I've done question three it says one hundred and forty seven thousand.

C3:   Right is that correct? Is one hundred and forty seven thousand one point four
        seven times ten to the power five? Yes it is isn't it. So listen if the if the answer on
        if the answer to the question is something which is small in length to be displayed

on your calculator in ordinary number way then that's how it's going to display it. So you may have to still do a bit of changing from a decimal number answer into a standard form answer. So you'll need to be thinking about whether the decimal number answers are really the same as these ones that we've got in standard form OK. You've checked all yours have you? On your calculator let me see you do one I want to see it. Do that last one for me I want see it displayed on your calculator.

P10: C3 how come eh sometimes it shows like the answer but then sometimes it shows

C3: Like I just said P10 if the answer is short enough to fit into the calculator display it will just display the proper answer. P21 bit busy just at the moment come and have a look in a minute.

Let's have a look then P20. Have you done it? Come on I want to see it I want to see it. No you've done it wrong. The last one's a division isn't it.

P20: Two   [inaudible]

C3: You've done it already P20 you should know what it is.

P20: [Inaudible] different four hundred   [unclear]

C3: So is that correct or not is four times ten to the power two the same as four hundred? Oh yeah. Eh have you got your home work written down?

Ps: Yeah

C3: Have you P14? Yeah go on then off you go. P19 don't go off with my calculator please.

Approximate percentage inaudible/unclear words 0.6

Gwers 2 Athro C4 Blwyddyn 8 Amser 9.05am

Lesson 2 Teacher C4 Year 8 Time 9.05 am

C4:   Reit *so* ddoe just i atgoffa oedden ni wedi cychwyn tynnu llun eh trionglau. Pa

        fath o yn gyfan gwbl mae mynd i fod tri fath o triongl da ni mynd i tynnu llun

        OK. Ydy P11 a em

Ps: Mae nhw efo nofio.

C4:   OK iawn. Mae na dri fath o driongl fyddan ni eisiau fyddan ni gallu tynnu llun

        erbyn diwedd OK. Y math gyntaf oedd beth ddoe? Pa fath o driongl oeddem ni

        wedi dysgu tynnu llun ddoe? P12.

P12:   Isosgeles.

C4:   Oedd o oedd yn digwydd bod yn un isosgeles ond beth ond doedd bob un ohonyn

        nhw ddim yn isosgeles oedd ddau o'r tri olaf oedden ni di wneud ddoe ddim yn

        isosgeles. Beth oedd yn arbennig am y tri am y trionglau oedden ni'n tynnu llun

        ddoe? Pa wybodaeth oedden ni'n gwybod am danyn nhw?

P1:   Oedden ni'n defnyddio cwmpawd.

C4:   Oedden ni'n defnyddio cwmpawd. Ond pam o'n ni'n defnyddio cwmpawd yn

        hytrach nag onglydd? Beth da chi'n gallu dweud wrtha I am bob un o'r trionglau

        oedden ni'n defnyddio ddoe? P4. Be oedd yn wir be oedd gyffredin am bob un?

P4:   [Silent]

C4:   Be oedd yr anhawster oedd y ddau yma oedd P1 a P12 wedi cael ddoe? Pa

        anhawster oedden nhw di cael wrth trio tynnu llun y siap o'r cychwyn?

P: Oedd yr ochrau yn wahanol.

C4:   Oedd yr ochrau yn wahanol oedden. Oedd un anhawster arall oedden nhw'n cael

        hefyd.

P: Oedd o'n tri deg centimetr.

C4:   Ie ie ond oedd hwnna oedd yna un peth yn achosi mwy o anhawster iddyn nhw
        oedd eh P2 wedi rhoi gair i mi ar cychwyn y wers.

P: Ongl

C4:   Ongl. Beth oedd gan 'run un o'r trionglau ddoe?

Ps: Ongl

C4:   Ongl. Be oedden ni'n gwybod amdanyn nhw?
        Pa wybodaeth oedden ni'n gwybod amdan pob triongl ddoe? Os na da chi'n cofio
        edrychwch nôl. Edrychwch yn eich llyfrau i weld be oeddem ni'n gwybod am bob
        un o'r trionglau. Pa wybodaeth oedd yn oedd yn gyffredin i bob un ohonyn nhw?

P: Oedd pob ochr yna.

C4:   Pob ochr. Be amdan pob ochr? P10.

P10:   Fel faint o *centimetre* [centimetr] [changes pronunciation to Welsh form]

C4:   Oedden ni'n gwybod hyd pob ochr yn hollol. Oedden ni'n gwybod hyd pob ochr.
        Oedden ni'n gwybod hyd pob ochr. So felly y math o drionglau oedden ni'n tynnu
        llun ddoe oedd em trionglau yn gwybod hyd pob ochr dyna'r math oedden ni'n
        tynnu llun ddoe. Sut oedden ni'n gwneud hynna? Sut oedden ni'n tynnu llun o
        heina? Be oedden ni'n defnyddio?

P1:   Cwmpawd.

C4:   Cwmpawd. Be dwi eisiau chi wneud yn eich llyfrau rwan mi ddoi o amgylch i
        checkio em tynnu llun hwnna yn sydyn iawn OK. Dwi eisiau chi yn eich llyfrau
        tynnu llun hwnna yn sydyn iawn gyda pren mesur a rhywbeth drost eich ochrau
        chi [**unclear**] fel bod fi'n gallu dod yna i wirio fo a *checkio* fod yn gywir.

Ps work silently.

P: C4 methu agor.

C4:   Be dio cau agor? T'im yn gallu rhoi dy bensil yn y fo na ti.

Ti di wneud o just checkio fo faint dy nhw wyth naw chwech wyth naw chwech

perffaith da iawn ti good. Da iawn P6. Just rho braslun bach wrth ochr hwnna

wedyn o'r triongl dwi di gofyn ti i dynnu llun o.

Just weld os wyt ti'n gywir wyth.

P: Saith.

C4:   Dwi di *checkio* hwnna dwi'n amau bod dy gwmpawd di di symud. Os da chi wedi

orffen just rhowch eich llaw i fyny fel mod i just yn gallu dod i gwirio fo *checkio*

fod o'n gywir. Iawn cofiwch setio'r cwmpawd i'r hyd cywir. Mynd i'r un pen

newid y maint mynd i'r pen arall. Da iawn os da chi wedi gorffen wedyn rhowch

y teitl nesaf lle da ni am fynd i edrych ar trionglau rwan lle da ni'n gwybod hyd

dau ochr a da ni mynd i fod yn gwybod yr ongl rhwngddyn nhw hefyd. Iawn. Ti

di wneud o? Chwech wyth wyth naw hwnna fan hyn chwech mynd i fanna.

Checkio un pawb? Ddim cweit yn naw nacdy o. Ti di wneud o? Da fachgen.

Good. Dwi di bod rownd pawb do ti'n wneud o rwan?

P: Na eh

C4:   I fanna ti'n wneud e ia? *Just checkio* ta chwech na da iawn ti good

Ps enter the room.

C4:   Reit nofio ie eisteddwch yn fan rhywle yn y blaen ma.

Ti di wneud o?

C4:   P1

P1:   Does gennai ddim y peth.

C4:   Onglydd bydd rhaid benthyg te. Bydd rhaid i ti just rhannu efo rhywun. Cer i
        eistedd wrth ochr P12 a wedyn gall chi'ch dau weithio gyda'ch gilydd. Oes gan
        pawb arall onglydd? Neu oleiaf un rhwng dau? Oes?
        Reit em dwi eisiau dau wirfoddolwr arall rwan o na be nawn ni mi drafodwn ni'r
        peth i gychwyn efo a wedyn wnawn ni trio gweld os ni gallu tynnu llun hwnna.
        Unrhyw syniadau be da chi'n meddwl sut da ni'n mynd i dynnu llun y triongl yma
        rwan. Rhywun heblaw P1 achos oedd o i fyny ddoe. Oedd P12 fyny ddoe. P10.

P10:   Em wneud yr un un peth ond fel tynnu'r llinell gwaelod

C4:   OK so tynnu llun yr un un eto

P10:   Gwneud em chwech centimetr

C4:   Ie

P10:   A dwi ddim yn gwybod wedyn.

C4:   Ddim yn siwr wedyn. P7.

P7:   Wneud y llinell gwaelod wedyn defnyddio em onglydd i fesur pedwardeg gradd
        wedyn tynnu llinell gan [unclear] a mesur chwech centimetr.

C4:   Be amdan y trydydd ochr?

Ps: Cysylltu.

C4:   Cysylltu'r ddau ben gored. OK mae henna'n swnio digon decha i fi. Sut da ni'n
        defnyddio onglydd? Sut da ni'n defnyddio onglydd? P6

P6:   Rhoi y em dim wedyn.

C4:   Dydwch mae hwn yn alreit dwi am ddangos onglydd i chi rwan. Dydwch mae
        hwn em hwn di onglydd chi mae gen chi un *super duper* iawn em lle mae hwn

mynd i fynd. Gad i mi gad mi wneud be da chi'n dweud be i mi wneud ta. Dwi

mynd i wneud hwn be oeddech dweud oedd o saith reit mi wnai wneud o ychydig

yn fwy na hynna fel bod ni'n gallu gweld. OK na fo cofiwch fod hwnna yn saith

centimetre mae o'n saithdeg ond fel bod ni'n gallu gweld o mae hwnna'n iawn.

Lle P6 fasa ti'n rhoi hwnna rwan?

P6:   Em rhoi y dim ar waelod y llinell.

C4:   Reit.

P6:   A wedyn tynnu llinell ar pedwardeg

C4:   OK. So be rhoi o fanna?

P6:   Na. Y pen

C4:   Y pen. Be sydd am fod ar y pen? Fel yna te. Dim mynd i fod ar y pen fel yna.

Ps: Na Canol

        Fel yr Oval

        Ar y pen

C4:   Be ydy'r enw da ni mynd i roi i hwnna te?

        Be di hwnna? Be fuasech chi. Sut fuasech chi'n disgrifio hwnna fel yr *oval bit* na

        da chi'n son amdan. Beth ydy o?

P: *Dip*

C4:   Ie ond be sy'n arbennig amdan y *dip*. Sut dwi. Pam fod y *dip* mae o.

Ps: Canol

C4:   Reit canol y be. Be ydy'r peth ma.

Ps: Onglydd.

C4:   *Good. So* dwi'n rhoi canol yr onglydd yn fana

P1:   Mesur pedwardeg wel cael pedwardeg gradd

C4:   OK *then* so dwi mynd i rhoi marc neu llinell neu be?

P: Marc bach

C4:   Marc bach OK. *So* mae marc bach fi fanna yn bedwardeg. Be dydis di wedyn P7? Dwi di marcio yr ongl rwan o bedwardeg.

P7:   Em wedyn ti'n mynd wedyn cer i'r llin em pren mesur em fewn llinell efo'r marc yna ond mesur chwech centimetr.

C4:   Fel na?

P: Na

C4:   Ie neu na?

Ps: Ie

C4:   Pam ddydist ti na just allan o ddiddordeb?

P1:   Ydyn ni'n dal defnyddio onglydd.

P: Cwmpawd

C4:   Dwi eisiau defnyddio cwmpawd tro ma?

P: Na

C4:   Pam ddim? Pam bod fi ddim mynd i ddefnyddio cwmpawd tro ma?

P: Ongl

C4:   Dwi'n gwybod ar ba ongl mae'r llinell yn mynd i ffwrdd a dwi di mesur yr ongl hynny so nawr mae'n bosib i mi ddefnyddio pren mesur so just rhoi hwnna fanna em top. Be rwan P2.

P2:   Cysylltu'r llinell chwech centimetr i'r un saith centimetr.

C4:   Fel na.

P2:   Ie

C4: Cysylltu'r ddau ben. Wneud ychydig yn well na fi ie

P1: C4

C4: Ie

P1: *When* bydden ni'n gwybod be di faint yr ochr

P2: Faint ie

C4: Falle bydden nhw'n gofyn i chi mewn arholiad falle bydden nhw'n gofyn i chi beth ydy hyd hwnna sut wedyn bysen ni'n ffeindio be sydd eisiau wneud wedyn i ffeindio allan be yw'r hyd olaf. P10 P13 sori.

P13: Mesur o.

C4: Ie just mesur o gyd ti'n gorfod wneud wedyn ydy fesur o dibynnu ar y cwestiwn mae nhw'n gofyn OK. Sut dwi mynd i ddangos i'r arholwr be bo fi wedi mesur a be dwi ddim wedi mesur?

P1: O rhoi rhoi y mesur ar yr ochr.

C4: Ie y pethe dwi wedi mesur labelwch nhw. So labelu hwnna dwi di mesur hwnna dwi hefyd wedi mesur hwn pedwardeg gradd dwi hefyd wedi mesur hwnna yn chwech centimetr. Iawn *so* rywfaint o bethau dwi di mesur labelwch OK. Reit dwi di dangos i chi yn fanna cyn i ni wneud o gawn ni sgrifennu y dull i lawr. Yn geiriau chi be fyddai cam cyntaf y dull yma?

P: Faint o le da ni'n gadael.

C4: Em faint o le da chi eisiau gadael e digon i dynnu llun hwnna a copio'r dwy llinell hwnna. OK. Hanner tudalen rhywbeth felly bydd o'n iawn.

P: C4 ydy ni'n tynnu llun [inaudible]

C4: Mi wnawn ni hwnna gallu tynnu llun braslun o hwnna i gychwyn efo a wedyn wrth ochr hwnna mi rown ni'r dull 'ma lawr a wnawn ni o'n fanwl gywir wedyn. Ie. Peth cyntaf da ni mynd i wneud yn y dull yma oedd tynnu llun triongl o wybod y ddau ochr a un ongl rhwngddyn nhw. P3.

P3: Tynnu llinell saith centimetr gyntaf.

C4: Gawn ni wneud o'n gyffredinol rwan dwi ddim eisiau gwneud o'n benodol ar gyfer hwn. Wneud o'n gyffredinol. P4 cam cyntaf.

P4: Em mesur wneud llinell saith centimetr.

C4: Dwi ddim eisiau gwneud o ar gyfer y triongl yma dwi eisiau trio wneud o ar gyfer trionglau yn gyffredinol. *So* bydd dull ddim just yn gweithio ar gyfer hwn bydd o'n gallu gweithio ar gyfer unrhyw triongl o gwbl.

P4: Gwneud llinell syth [inaudible word]

C4: Llunio llinell syth o hyd arbennig OK. Beth da ni'n wneud wedyn P9?

P9: Em mesur pedwardeg ar y onglydd.

C4: OK defnyddio onglydd mesur maint ongl.OK.
Dwi'n rhoi seren bach fan hyn. Be di'r rhan bwysig da ni'n gorfod cofio yn fan yma.

P: C4 be mae'n dweud ar ôl maint.

C4: Ongl. Pam da chi'n meddwl bod dwi eisiau rhoi seren fanna. Mae'n hawdd gwneud camgymeriad fan yma.

P: C4 ydy o cofio rhoi y llinell mesur llinell.

C4: Na da ni'n mesur llinell wedyn be di'r lle mae'n eithaf hawdd gwneud camgymeriad gan ddefnyddio'r cam bach yma. P12.

P12:   Rhoi y canol o'r onglydd ar y pen

C4:   Canol yr ongl. Lle da ni'n roi fo

P12:   Ar pen y llinell.

C4:   Diwedd y llinell. Pen y llinell. Un peth arall dwi eisiau cofio gwneud hefyd yn

ogystal a canol yr onglydd yma ar pen y llinell be arall mae rhaid dydist ti fo peth

cyntaf

P: Eh Cofio [inaudible word]

C4:   Na wrth defnyddio'r onglydd dydist ti un o'r pethau cyntaf dydist ti wrtha i.

Yn ogystal a cofio roi hwnna ar diwedd y llinell be arall oeddet ti di dweud wrtha

i o'n i'n gorfod wneud.

Rhywbeth amdan y dim ma. Be ddydist ti am y dim?

P: Cychwyn ar y dim.

C4:   Iawn. Lle oeddet ti lle oeddwn ni di rhoi y dim? Lle oedd y dim yna i fod?

P: Llinell syth.

C4:   Ar y llinell syth *good*.

Wedyn dwi di marcio'r ongl. Be sydd angen ei wneud wedyn. Be wnes i wedyn ar

ôl marcio'r ongl P7. Be wnes i ar ôl i mi farcio'r ongl?

P7:   Em tynnu em llinell em.

C4:   Dyna llinell yna. Ond sut o'n i'n gwybod be oedd o? Be o'n i'n di wneud Sut o'n

i'n gwybod bod y llinell mor hired a hwnna?

P7:   Mesur.

C4:   Ia mesur marc y llinell hyd marcio llinell syth.

P1:   C4

C4: Ia

P1: Os mae fel hwn yn dod fewn i'r [inaudible] efo gradd gallwn ni wneud o fel be oedden ni'n arfer wneud o wedyn roi em *checkio* os mae'r gradd yn gywir neu ni gorfod wneud o.

C4: Ti gwybod fel oedden ni'n. Ti'n gwybod be oedden ni'n wneud ddoe

P1: Ia

C4: Be oedd yn arbennig i ni ddoe oedd hwnna. O'n ni'n gwybod be oedd maint y tri ochr doedden ni. Broblem efo hwn ydy sut dwi'n gwybod beth i setio'r cwmpawd i yn fan yna

P1: Ia ond os da ni'n wneud fel saith centimetr a chwech centimetr yn gyntaf.

C4: Ia

P1: A wedyn gweld.

C4: Gad i mi Gad i mi Os mae dweda bod hwnna yn saith a rwan dwi mynd i fan hyn a dwi mynd i marc o chwech ie. Sut dwi'n gwybod achos fase'r arc arall yma fasa'n gallu croesi yn fanna fanna fanna fanna fanna dwi ddim cweit yn siwr lle ar yr arc cyntaf yna mae o mynd i groesi nac ydw i? Iawn. Basa'n bosib i bob un o rheina fod yn gywir ie so mae'n amhosib i mi ddefnyddio cwmpawd yn yr achos yma. Mae'n amhosib OK. Sa'n bosib wyrach i farcio hyd hwnna ond waeth i ddefnyddio pren mesur i wneud hwnna ie. Ar ôl i mi fesur hyd maint yr ail linell ma be dir peth arall dwi'n wneud? P3.

P3: Wneud em cysylltu dau llinell.

C4: Cysylltu dau ben. Perffaith. Reit gwnewch o. Gwnewch rwan be dwi di wneud yn fanna.

Ps working silently.

C4:   Reit os da chi wedi wneud hwnna be dwi eisiau chi wneud ydy cwestiwn dau ar

chwechdeg wyth

C4 helps Ps individually.

C4:   Wnai *just checkio* fo. Wnai just *checkio* fo di hwnna ddim yn bedwardeg. Gai *just*

checkio be da chi wedi wneud. Just i marcio bod nhw'n gywir. Byddwch yn

ofalus efo maint yr ongl lle mae'r dim lle mae'r dim. Lle o'n i di dweud am y peth

dim ma. Oedd canol yr onglydd ar pen y llinell a'r dim ar y llinell syth mae'n

bwysig peidiwch yn enwedig efo rhai onglydd cyfan peidiwch a cwympo mewn

i'r trap o rhoi y dim fyny fan yna gwnewch siwr bod y dim wastad yn fflat iawn y

dim wastad i fod yn fflat.

Edrych yn fawr braidd OK.

Mae hwn edrych yn well.

Mae hwn yn berffaith da iawn ti P6.

Da iawn ti. Mewn ffordd efo rhein mae'n haws efo onglydd hanner crwn ddim yn

gallu wneud y camgymeriad bod o mynd fel yna. Efo un hanner crwn da chi'n

gwybod bod o'n mynd yn fflat. Da iawn ti. *Good*. **[Inaudible-personal mic off]**

Gwenud siwr bod y dim yn fflat

Na ti. Da iawn.

P: C4 os does na ddim digon o le i wneud yr ail un.

C4:   Dwi ddim yn credu bod yr ail un yn ofnadwy o fawr. Cer i top y dudalen nesaf

P1:   Be da ni'n wneud ar ôl gorffen.

C4:   Un dau tri b a d just wneud b a d hefyd wedyn dwi'n mynd ymlaen i'r un olaf

        dyma gwaith nesaf dwi just am roi nodiadau i chi yn fan hyn heddiw wedyn heno

        bydd y gwaith cartref ar tynnu llun triongl o wybod un ochr a dau ongl OK.

P1:   C4 ni'n gorfod tynnu llun em.

C4:   Braslun?

P1:   Braslun.

 C4:   Ie braslun just rho braslun bach wrth ochr fel bod ti'n gwybod.

Ps work quietly.

C4:   Pum munud ie just i orffen cwestiwn dau ar y tudalen iawn.

        Checkio rhein. Be ti di mesur pa chr ydy cofia labelu ochrau sut i wneud.

        Ti di mesur o'n fanwl gywir. Da iawn good

P: [Inaudible]

C4:   Tria fo wedyn os mae'n mynd dros paid a poeni. Da iawn cofia labelu good.

        Mawr braidd.

        Good.

P: C4 ochr

C4:   Sori

P1:   C4 ti'n gwybod ar y peth

C4:   Sori ar pa un?

P1:   Na ti'n gwybod ar ôl i da ni

C4:   Ie just rho rhif tri

P1:   Ie.

C4: Hwnna fel dy deitl. Tynnu llun o fo eto ond dwi eisiau meddwl sut fyddech chi yn cychwyn mynd o amgylch tynnu llun y siap nesaf yna.

Cwpl o funudau ie. Da iawn ti. [Inaudible] Good.

P: Eh C4

C4: *Just* copio'r teitl a wedyn dwi eisiau ti feddwl sut basa ti'n tynnu llun hwnna.

P: Sut mae gwneud hwn?

[Inaudible]

C4: Sa chi just yn gorffen yr un da chi arno os na da chi cweit wedi gorffen gyd dim problem ond just gorffennwch y rhan da chi arno. OK. Wedyn wnai just rhoi cwpl o funudau i chi feddwl amdan wedyn sut da ni'n tynnu llun hwn. A wedyn mae P6 mynd i ddweud wrthom ni sut mae hi mynd i dynnu llun o.

P: [Inaudible]

C4: Wel wnawn ni efo'n gilydd mewn munud. Paid a wneud o eto. Wnawn ni o efo'n gilydd mewn munud. Iawn

Pawb wedi pawb wedi gorffen do? Pawb wedi cael amser i ystyried hwn. *Go on then* P6 sut basa ti'n tynnu llun hwnna?

P6: Tynnu llun y llinell wyth centimetr.

C4: OK.

P6: Wedyn wneud y pedwardeg gradd y llinell a wedyn rhoi chwechdeg gradd a wedyn cyfarfod.

C4: Sut on i'n gwybod hyd y ddwy llinell?

Ella bod hwnna'n gwestiwn anheg. P4.

P4: Lle mae'r ddau llinell yn cyfarfod

C4: *So* oes angen i mi wybod beth yw hyd y ddwy linell?

P4: Nagoes.

C4: *Good. Good. So* er be oedd P6 wedi dweud wrtha i oedd hi di dweud oedd hi di dweud tynnu llun yr wyth i gychwyn efo gad i mi wneud hwnna oedd hwnna'n wyth be ddydist ti wedyn marcio be?

P6: Marcio gwneud y pedwardeg gradd.

C4: OK. *So* dwi di rhoi fy onglydd i fan hyn i mi drio wneud o rhyw fath o o gywir. Ongl ni yn fanna marcio pedwardeg OK. Wedyn?

P6: Wedyn wneud y chwechdeg gradd o na wedyn rhoi wedyn rhoi llinell

C4: Llinell trwy hwn?

P6: Ie

C4: Dio wahaniaeth be di hyd o?

P6: Na.

C4: OK. *Roughly* fanna.

P6: Wedyn wneud y chwechdeg gradd.

C4: Wneud y chwechdeg gradd. Eh chwechdeg fanna

P6: A wedyn wneud llinell [Inaudible]

C4: [inaudible] cyfarfod

C4: Ydy'r dull yn iawn?

Ps: Ydy.

C4: *Good*. Perffaith da iawn ti. Rwan te be dwi mynd i ofyn i chi wneud ydy ysgrifennu dull chi eich hun i lawr oedd ffordd oedd P6 wedi dweud wrthom ni yn

berffaith OK. Da ni di dangos i chi mae P6 wedi trafod dwi eisau chi rwan sgennu lawr y dull ar gyfer wneud hwn.

P: C4 ydy ni'n wneud llun o hwnna?

C4:   Da chi'n wneud llun o hwnna wedyn ie wneud llun o hwnna wedyn. Dull ma lawr mewn geiriau eich hunan.

Recording stopped. Approximate percentage inaudible/unclear words 0.34%

Appendix 9   Fieldwork observation sheet   *Taflen arsylwi gwaith maes*

Lesson*/Gwers*_____   Time/*Amser*_____   Teacher*/Athro*_____

Topic/*Testun*_____Type*/Natur*_____

Year/*Blwyddyn*_____   W=whole, G= group, I=Ind, CS=CodeSwitch U= Uniform

Period/ *Cyfnod*	**Board writing/*Ysgrif Bwrdd***	Type of communication/ *Math o gyfathrebu* ✔		*Characteristics/*Nodweddion			
				T CS	U	P CS	U
0-10mun		**W**					
		G					
		I					
10-20mun		**W**					
		G					
		I					
20-30mun		**W**					
		G					
		I					
30-40mun		**W**					
		G					
		I					
40-50mun		**W**					
		G					
		I					
50-60mun		**W**					
		G					
		I					

Classroom plan/*Cynllun dosbarth*

Appendix 11

Questions for respondent validation

Cwestiynau ar gyfer dilysiant atebwr

1) Can you clarify the linguistic background of the class. How many pupils and second language learners were present? Roughly what percentage is this?

   Allwch egluro cefndir ieithyddol eich dosbarth. Faint oedd yn ddisgyblion ail iaith. Tua pa ganran yw hyn?

2) Did you notice any differences between policy and practice in the transcripts? What were they? How might you address them?

   A wnaethoch sylwi ar unrhyw wahaniaethau rhwng polisi ac ymarfer? Beth oedden nhw? Sut wnewch chi ymateb?

3) What was your impression of the structure of the lessons?
   Was this as planned? Has it been developed by you, the department, LEA or elsewhere?

   Beth oedd eich argraff o ffurf y gwersi? Fel hyn cynllunwyd nhw? A'i chi datblygodd y ffurf, neu'r adran neu yr Awdurdod neu rhyw gorff arall?

4) What did you think of the pupils' contributions? Have you any examples?

   Beth oeddech yn meddwl o gyfraniad y plant?Oes unrhyw enghreifftiau?

5) What did you think of your own use of language in regard to:

   a) The type of questions given (open/closed)

   b) The form of your evaluations

   c) Use of Welsh terminology.

   d) Response to Welsh terminology.

   Was this as expected?

   Beth oeddech yn meddwl o'ch defnydd o iaith mewn perthynas â:

   a) Natur y cwestiynau â ofynwyd (agored/cauedig)

   b) Natur eich gwerthusiad

   c) Eich defnydd o dermenoleg Cymraeg

   d) Eich ymateb i dermenoleg Cymraeg

   Oedd hyn fel y disgwyl?

APPENDIX 12

TEACHERS' PERSPECTIVES ON THE CLASSROOM DATA

Notes on the interpretation and analysis of the data from this phase of the fieldwork

Introduction

On completing the transcriptions, I returned the texts to the individual teachers involved via their head of department in sealed envelopes. I made it clear that they had part ownership of the data and could use it for their own purposes including their own professional development. I did not discount teachers combining their own analysis of data to aid the development of their departments. This open and democratic approach was adopted in order to dispel concerns that could have been applied to earlier data collection exercises.

Ideally, I wanted to include the voices and interpretations of the teachers involved in order to triangulate my observations, I did this by asking the teachers by letter (see appendix 10) if they would be willing to participate in a follow up interview after they had had a chance to look at their data. I gave them two general questions, see below, to prepare themselves for such an interview, but also gave them the option of replying in written form if it suited them. The general questions posed were:

3)   Which parts of the transcripts were different from your expectations?

4)   In what way were they different?

Comments made by the teachers involved in the audio recording of lessons

The questions I used to elicit feedback from the teachers involved in the classroom recordings can be seen in appendix 11.

School C

I returned to school C first, where interviews were carried out in C1's classroom. As before, however, the interviews became semi structured with questions arising within the framework provided by the appendix material. These interviews allowed me to check the accuracy of my transcripts, and in one instance, this changed my interpretations.

I will begin with some of the comments made by teacher C1, an experienced head of department.

C1 found no difference between policy and practice in the texts, but expressed surprise at the amount of teacher talk in the lessons particularly one of the lessons, the third. In regard to the structure of the lessons, C1 said that they, the department, did not have a rigid policy, but they tried to follow, broadly, the three part lesson structure that I referred to earlier and contained in literature from the QCA. C1 said the pattern had not come from the LEA and that it was regarded as good practice within the school and followed on from primary school developments. C1 pointed to the second lesson, which was a different kind of lesson in the IT room, possibly as an example that the department varied its teaching style.

C1 expressed satisfaction with the pupils' contributions, and explained, again referring to lesson 3, that although there was a high level of teacher talk, which was required to work through the information on the interactive white board, there was plenty of pupil involvement. C1 said that there was always an attempt to use a variety of different questions and felt this was the case in these lessons, although there was an acknowledgement that C1 had not looked at that aspect in great detail. Moving on then to consider teacher evaluations, C1 said that there was always an attempt to build on responses and that this year 8 class always gave pretty good responses.

With regard to the pupil using word play, "p^mp" C1 clarified that it did not happen frequently, but went on to explain it did happen particularly in year 7 with pupils who had some Welsh teaching background in primary school. It seemed that some of these pupils tended to continue using the names for shapes, for example, because they were not aware of the English names. In general, C1 expanded, the tendency would "fade" by year 8 and 9 as they became "more accustomed to working completely through the medium of English."

In discussing the use of small dry wipe white boards, C1 explained that they were useful for assessing the understanding of a whole class either prior to, or after teaching a topic. Apparently, everyone in the department had them and everyone used them, but some more than others. Finally, C1 explained that the banding system was not the preferred option of organizing year 8 and that, where possible, the department would aim

for years to be streamed by ability. It seemed, however, that non-departmental considerations had determined the organization of the present year 8 along banded lines.

I saw teacher C3 next. C3 spelt out the linguistic background of the English medium year class, the pupils all had English as a first language to C3's knowledge. C3 had found a real difficulty in reading the transcripts and therefore did not have a feel for the lessons. In regard to the structure of the lessons, C3 could not remember the detail, but said that the class had got through what was intended and called the approach algorithmic i.e. step by step. C3 thought there was a mixture of different types of questions over the course of the lessons, but felt unable to point to examples in detail. The pupils' contributions were evaluated as generally pretty good, whilst C3 acknowledged some need for intervention occasionally. C3 expanded slightly on this and went on to say the class was reasonably responsive and indicated that usually classes were less responsive. C3 did remember instances where pupils' responses had been built upon, turned around when they were wrong and made more positive. Expanding slightly on the teaching approach adopted, C3 said the aim was to get things going in the right direction with closed questions before opening out and asking for reasons.

In relation to answers involving Welsh numbering by pupils, C3 explained that a Welsh response was more likely from P2 than P6, I therefore revised the transcripts so that the interaction was attributed to an unidentified pupil. C3 did point out, however, that it may have been P6 as the pupil was in the "bridging" group or "cross-over" group.
In regard to the evaluation, "Why" by C3 to the Welsh numbering response "chwech" [six] and the possibility that it may have been more complicated and therefore different from other evaluations, C3 said there may have been many different reasons for the possible difference and gave a selection of reasons such as: what stage of the lesson they were at, the tone of the question or the answer, the assessment of the pupil's understanding and finished by underlining the form of the evaluation had nothing to do with the language.

On being asked about the frequency of the same pupils responding to questions typified by C3's comment "same hands" in the third lesson, C3 stated it was "common". In relation to the small white boards, C3 described how their usefulness varied from being "distracting" to being very "productive" depending on the group. Difficulties with

the white boards were pointed out in that the teacher could not always be sure that the answer belonged to the pupil and therefore their use was treated with caution, C3 also made clear that the boards were impractical because pens ran out or the boards were a mess. Despite this, however, they were sometimes useful.

Turning now to teacher C2 the least experienced of the teachers taking part in the project. C2 began by clarifying the language background of the small year 10 group. Two of the pupils were thought to be from English speaking backgrounds, speaking English frequently at home, whilst the six others were thought to be from a Welsh speaking background with at least one parent having the ability to speak Welsh.

C2 said that there did not appear to be any deviation from policy to practice in the lessons and expressed satisfaction with the form of the lessons because of the worksheets that had been written and because everything seemed to "flow" as in stopping to check everyone's answers, increasing the pupils' confidence and seeing that the pupils' understood the work. Pupils were said to be quiet because of the recording, but they were the type of class, because of their high ability, that could be given instructions and could then carry on independently. C2 expressed surprise in the amount of Welsh used and thought that there would have been more English coming through in the interactions with the pupils, but acknowledged using a couple of English terms.

The use of some English terminology was attributed to a background of English medium higher education amounting to six years of learning. C2 also pointed out that because lessons sometimes alternated from one language to the next it meant that languages could be mixed. The use of terminology was considered as something that might be looked at. C2 then began to explain that the classrooms were being upgraded with interactive boards, before describing small dry wipe boards as being of less use, it seemed C2 preferred pupils to put their hands up.

I saw teacher C4 after the school day had finished. C4 stated that there was no difference between policy and practice in the classroom and that the aim was to try and use as much in Welsh as possible and give the pupils English words quite rarely. When I asked for clarification why this was attempted, C4 said the pupils appeared to cope with Welsh and did not ask what the word was in English. C4 said sometimes parents asked

about words at which point similar books would be sent home. It was reiterated, however, that pupils had no problem at all with terms in one language.

The structure of lessons according to C4 was meant to follow a brief recap of previous learning before aiming to "chunk" the lesson so that the pupils concentrated without the lesson dragging on. Pupils' contributions were summed up as positive considering the changes in the classroom environment. C4 also said there seemed to be little difference from their usual behaviour. Some surprise was expressed at the amount of English present, which did not correspond with my view. C4 explained that considering their background, the group were very Welsh orientated in the way they spoke and reacted with each other and the teacher, and pointed to another group with similar backgrounds who were more English orientated. Towards the end of the interview, C4 admitted to not using small white boards and said that perhaps they should be used to help with assessment and prevent pupils hiding in class, remaining quiet and being prepared for others to give answers, which seemed to be a description of a situation arising from the symbolic order.

Around the theme of participation, lack of confidence was given as a reason for a couple of pupils not participating in the class, one low ability pupil was said to lack confidence and tended to think that the problem could not be done before starting. On the other hand, C4 also pointed out that two pupils were extremely confident and tended to contribute more. This wide spread of ability brought up the question of whether this small class would be divided at some point; C4 thought the class would be divided into two groups for GCSE if the finances were available, as this had occurred previously.

I will now summarise the comments made by the teachers in school C, who were working along mainly parallel and near monolingual lines. What becomes relatively obvious from the feedback attained from these interviews is that the teachers appear to be, on the whole, content with their efforts with some individual concerns being attended to by each of them. C1 attended to the possibility that there was too much teacher talk in one lesson on two occasions. C1 explained the occurrence of word play by a pupil, which may be related to a concern expressed by Baker and Jones (2003) about the constant movement of pupils from first language programmes to second language programmes the

repercussions of which are not well appreciated, but did not comment on the nature of the response to the pupil. Pupils' use of an unofficial language in the classroom was said to "fade" over time. Of course, this gradual disappearance might be mis-construed by C1. It might be an indication of less participation by those pupils on the floor of the classroom over time. To ascertain, however, whether these types of pupil are switching medium to the official language of the classroom or simply remaining silent having been positioned less favourably by the grammar and lexicon of teachers and peers, would require more longitudinal research over the course of such pupils' entire school careers. Such research would, of course, be a recommendation emanating from this study.

C3 attended to concerns over discipline by commenting on the need for some intervention and attended to participation by pointing out the class was more responsive than others and gave constructive reasons for the nature of an interaction involving a Welsh response which fitted with the development of questioning from closed to open forms. C3's explanation, however, might also be construed as symbolic domination and indicative of inertia within institutions. If this were slippage, it would obviously be an opportunity to develop inclusion.

The two Welsh medium teachers attended to the level of Welsh spoken by them in the classes and seemed to have different perceptions, with C2 expressing satisfaction with the level of Welsh attained, possibly due to a mixed language background, whilst C4 appeared to be concerned with some slippage. Neither of the Welsh medium teachers brought up scaffolding in English for the English first language pupils. Both Welsh teachers, however, began to reflect on the use of their Welsh terminology. For example, C4 queried whether English terminology should be used more with Welsh terminology and related this to what the pupils would need outside of school. Whilst C2 attended to the nature of the terminology by suggesting it was something to look at. On the whole, both the Welsh medium teachers seemed concerned with attaining a high level of Welsh language use, which might have been an indication of a hierarchy of discursive practices around them.

School A

By the time I visited school A for the last time, teacher A1 had upgraded the resources in the classroom. Now there was an electronic white board being put to use driven by a lap top. I interviewed teacher A1 in the mathematics classroom at the end of the school day and recorded the discussion. A1 again gave a broad background to the linguistic make up of the year 8 class. Most of the pupils were from Welsh first language backgrounds, some were from mixed language homes and some were from English speaking homes. All the pupils had been to primary schools where they had received their education through the medium of Welsh from the beginning. Some, however, may have come to the area at a later stage. A1 explained that many of them were doing mathematics through the medium of Welsh, and gave the figure of ten out of twenty four.

No policy slippage was observed by A1, and indeed A1 attended to reaffirming the bilingual policy of introducing terms bilingually and notes bilingually. The structure of lessons was described as including teacher directives and plenty of practise for the pupils. The pupils' contributions were said to be open with no one "afraid" to answer. The class was summed up as being especially good. A1 aimed to include open questioning, but said the nature of the subject dictated closed questions, which would sometimes involve not accepting the first answer given by a pupil and asking two or three pupils for their answers possibly evolving into a discussion into the merit of an answer. In relation to the use of Welsh terminology, A1 expressed the hope that it was correct, again attended to the bilingual aspect and compared the use of terminology with that in a designated school in a more urban area by saying there would be more English.

A1 then attended to a concern in relation to the mixing of languages, which was evaluated as perhaps not being a good thing, but it was partly deliberate in order to support those doing work through the medium of English. In relation to small white boards, A1 told me they were a good way of spotting pupils who were struggling, and gave a wider indication of pupils' understanding. A1 was less sure that different forms of questioning might result in different responses (That is, the form of a question might facilitate the construction of a linguistic hierarchy) and in regard to pupils' silent response to a general question (Lesson 1) clarified that hands up were expected at this

point, although on another occasion an explicit request was made for pupils to raise their hands.

After interviewing teacher A1, we went to find teacher A2 who was busy sorting pupils' external examination papers. A1 and I waited in the staff room whilst A2 finished the work. Eventually, A2 came to the staff room and decided the interview would be best conducted in A2's classroom, but as this was being cleaned we moved next door.

A2 affirmed that three of the pupils in the year 10 set 2 were Welsh medium pupils, the total number in the class was given as roughly thirty. All the pupils were bilingual. A2, however, felt unable to give the language background of the pupils, but was able to say there were pupils from non-Welsh speaking homes present. In regard to differences between policy and practice, A2 said three things stood out. Firstly, my presence possibly meant that more Welsh than usual was used. A2's aim was to be fairly bilingual as there were pupils doing mathematics in Welsh and others doing it in English and also give everyone a bilingual background. But A2 felt that much more than half the talk was in Welsh and reiterated that it may have been because I was there, and possibly because A2 was happier in Welsh, (This was a sentiment that resonated with feelings expressed by teacher B2). Secondly, A2 attended to a personal belief in praising children, but felt that some routines in the scripts did not correspond to this. Such as

P: Saith deg dau   [*Seventy two*]

A2:   Saith deg dau   [*Seventy two*]

A2 felt that " Ie da iawn saith deg dau" [*Yes well done seventy two*] would have been more in keeping with a belief in praising and increasing confidence in children, and then gave reasons for repeating answers; these were making sure everyone had heard and also in case someone had got an answer wrong. I suggested that the form of the interaction might count as a confirmation and A2 agreed, but continued by saying although it might not be possible to say "well done" every time, an aim was to get rid of pupils' lack of confidence in mathematics. Perhaps in raising this, A2 was addressing the discontinuity apparent in the classroom interaction. It should be remembered also that according to Jaffe (2003) such evaluative moves by the teacher define the legitimate classroom talk. Thirdly, A2 also attended to discipline and a method of attaining it- the use of "shsh"

which A2 did not approve of when used by other teachers. A2 said there were too many of those in the texts, but also referred to the nature of the class, in particular two pupils sitting at the back who would tend to talk across the teacher and made the work difficult, P1 and P2.

In regard to the structure of lessons, A2 commented that the nature of the text-the absence of punctuation and timing-made it difficult to follow and I would agree that that would be an area to improve upon in future work. A2 did not notice anything in regard to the use of Welsh terminology, but again attended to a concern around the mixing of languages, stating that the aim was to have complete sentences in one language, either Welsh or English. The frequency of the linguistic changes was not a concern. Similarly, the language of a pupil's response was not a worry; often if a pupil responded in English, A2 said an evaluation would be in Welsh to ensure that everyone understood. I suggested that at the beginning of the third lesson, during a period of sustained Welsh medium education, pupils seemed less inclined to take part. A2 attended to this by referring to an appraisal that pupils had made in regard to mathematics teaching a year earlier, not one of the pupils had mentioned that A2 was using too much Welsh, which might correspond with A2's earlier assessment that the lessons recorded contained more Welsh than usual. The interview concluded with A2 expressing a feeling that there should have been more English present in the texts given the bilingual nature of the class.

To summarise the comments made by the teachers in school A in response to the data, the comments appeared to attend to an ideal form of bilingualism, with both teachers expressing concerns over mixing languages. Neither teacher picked up on the nature of the Welsh and English used in the classrooms, in terms of constructing a hierarchy of language within the domain of mathematics by occasional slippages from the ideal. And it is probably those areas of slippage that have been highlighted in this study, which need to be addressed in the interests of increased levels of participation by all pupils.